THE
VETERINARY JOURNAL

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Editorial

TUBERCULOSIS

THE subject of tuberculosis is so ever present with us and so very prominently in front of us, both in the professional and the lay press, that no excuse is needed for the devotion of a special number of the VETERINARY JOURNAL to articles bearing on this subject. It interests to an equal degree the veterinarian, the medical man, and the general public, for its ravages are observed by all. In the space at our disposal we have endeavoured to include articles of interest to everyone, and the contributions on the subject illustrate both its importance and the great amount of thought which is devoted daily to its suppression. Since the discovery by Koch of the causal organism many great advances have been made both in animal and human pathology, but a perusal of even only the articles in the present pages will show how much yet remains to be done, and at the same time it shows how great is the advance and the amount of progress which has already been made. The different classifications of the respective causal organisms of tuberculosis into human, bovine, and avian, brought us a great step forward, and the discovery of the power of tuberculin as an aid to diagnosis helped matters very much. With the help of tuberculin the farmer and breeder can at all events know how he stands in regard to the question of tuberculosis amongst his stock; but this agent, which is of such importance for diagnostic

purposes, should be under Government control and only obtainable by medical men and veterinarians. If the idea of vaccination, which is now on its trial, proves to be of value as a preventive and immunising agent, we shall find in it the means for building up tuberculosis-free herds without impossible expenses and sacrifices.

We draw especial attention to the articles by M. Guérin, a distinguished French veterinarian, who is the collaborator with Dr. Calmette (another illustration of the value of combination between the human and veterinary branches of medicine), and Dr. Nathan Raw, a distinguished medical colleague, on the question of immunisation, whilst the subject of the control of tuberculosis in our milk supply is dealt with both by Medical and Veterinary Officers of Health. It is the question of the cow with the tuberculosis udder, and its effect on those who drink the milk, which is occupying so much necessary thought at the present time; and the sooner the Tuberculosis of Animals Order (which was in force in 1914), or some modification of it, is put back into the Statute Book, the better will be the result on our herds and on mankind. There is no better disease amongst the whole category of ailments from which man, animals, and birds, suffer, than that of tuberculosis for illustrating the value of combined team work between the workers in veterinary and human medicine; and if we, on our part, can eradicate even only the tuberculosis distributor from children's milk supply, the veterinary profession and the veterinary training will have again proved that it holds an absolutely unique and necessary position in the scheme of Public Health for the prosperity and welfare of the community.

The question of clean meat too, although not of such urgent importance in this country as in some others (owing to the fact that we invariably cook our food thoroughly), is another one to be brought up; and here again the veterinarian is, by virtue of his training in the diseased conditions of the animals when alive and of the flesh when they have been killed, the best skilled man to select to adjudicate as to whether meat is diseased or not. His anatomy has taught him where to seek out and cut down upon the hidden gland structures, and his experience is the best one to act upon.

As to whether it can be considered fit to go into the shops as food for man the Medical Officer of Health will give his opinion; but in so far as disease affects the flesh of the cow the verdict must always be that of the veterinary surgeon.

The two can, and usually do, work amicably together, and there need be no overlapping. Each, the Medical and the Veterinary Officer, can be "top dog" in his own sphere, and the benefit to the public of this mutual collaboration will always follow.

General Articles

PROPHYLAXIS OF BOVINE TUBERCULOSIS BY VACCINATION.

By M. C. GUÉRIN.

The Pasteur Institute, Lille.

It does not seem necessary to emphasise the losses caused each year to cattle by tuberculosis. These losses result not only from meat seized as unfit for consumption, in the abattoirs or private slaughter-houses, but further, in the fall in milk production of the tuberculous animals, and the difficulty of fattening such subjects.

The urgency of the suppression of the disease is shown not only by these losses which before the war, according to Brittlebank, amounted to 25,000,000 francs in Great Britain, but more by the danger to human beings of bovine tuberculosis. We know quite well that the principal factor of the propagation of tuberculosis in man is the tubercle bacillus of human origin, but we also know that according to the country in which the statistics are taken, 4 to 10 per cent. of infantile tuberculosis arises from the bacillus of bovine origin. This relatively high percentage justifies the fears experienced through the transmission of tuberculosis of cattle to man.

It is for these two reasons, losses in money and danger to the public health, that an energetic campaign was undertaken some thirty years ago by eminent men like Nocard in France, and Bang in Denmark against bovine tuberculosis. This defensive action was based on the methodical employment of tuberculin, which Robert Koch had discovered. The minimum results obtained by Bang's method are somewhat qualified and inexact, but really where Bang's method has been strictly applied the deaths and disease from tuberculosis have *diminished.* The recent idea of carriers of bacilli, without reaction to tuberculin, explains why Bang's method, in spite of the strong hopes attached to its application, cannot suppress bovine tuberculosis. We come therefore to this conclusion, that if it is allowed that every animal which reacts positively to the tuberculin test is a carrier of tuberculous lesions, visible or invisible, one is not authorised to say that an animal *which has dwelt in an infected place,* even if it does not react to the tuberculin test, will not become tuberculous, although it has been removed from all new cause of contagion.

Tuberculin alone is quite insufficient to assure a perfect prophylaxis against bovine tuberculosis.

But, it may be asked, given the great number of men and animals

that are affected with tubercle bacilli from their first youth (as has been well shown by Behring in the case of man) why is it that all these subjects, cattle and human beings, do not die rapidly from the attacks of the malady? It is because every subject which harbours tubercle bacilli, and in which the intimate incorporation of the bacilli with the system has taken place, carries within itself the means of its cure, at least during the duration of the disease. This is why tuberculosis in all races is the type of a chronic malady compatible often during the whole of life with all the appearances of health. The test in bovines is extremely easy to make: *Tuberculous cattle resist massive experimental infections incomparably better than healthy ones.*

The conclusion which follows is that *in order to resist tuberculosis it is necessary to be tuberculous: one must react if possible to the tuberculin test.*

This eventuality, which would consist in impregnating the system with tubercle bacilli, cannot become realisable, however, if one is in possession of a bacillus "*non-tuberculigenous*," that is to say *harmless*, but susceptible, however, of playing an active rôle. The tubercle bacillus of bovine origin called B.C.G. (bacillus Calmette-Guérin) is fitted to play this rôle. Cultivated for thirty consecutive years in the presence of glycerinated ox bile it has acquired hereditary properties of innocuousness which render it harmless to all species, man included. Inoculated in a suitable dose *under the skin* of calves, *as soon as possible after birth, and at the latest within fifteen days*, the B.C.G. causes the formation of a small lesion about the size of a pigeon's egg, painless, and without any tendency to suppuration. The animal thus vaccinated reacts for several months to the tuberculin test. The positive reaction disappears at the same time as the vaccinal lesion, generally from the sixth to the twelfth month after vaccination. During this time the animal remains immunised against tuberculous infection.

As for the other active vaccinations (anthrax, erysipelas), the revaccination ought to be carried out every year. These new data are supported by very exact observations made at the Pasteur Institute of Lille, the details of which have been published (*Annales de l'Institut Pasteur*, May 1924). Actually experiments, extended to practice, have begun in France, Belgium, and Holland. In Great Britain also trials have been undertaken under the auspices of the Minister of Agriculture, and under the direction of Sir S. Stockman and S. H. Gaiger. In the human subject vaccinal inoculation under the skin of the new-born infant cannot be thought of; but considering the great permeability of the intestine in the first years of life, it is by ingestion that one proceeds in the child. Three doses of a centigram

each are thus given to the new-born infant on the 3rd, 5th, and 7th day, or the 4th, 6th, and 8th day after birth.

It may be stated definitely that the use of B.C.G. in animals and men is not followed by any harmful result. Its harmlessness is certain. Will this practice be absolutely effectual? Time alone will show.

PROTECTION OF CALVES AGAINST TUBERCULOSIS BY VACCINATION.

By NATHAN RAW, C.M.G., M.D.,
London.

THE remarkable susceptibility of some of the domestic animals to tuberculosis is well known to all veterinarians, and yet some of them appear to be so resistant to infection by the tubercle bacillus as to be almost immune, as, for instance, the dog, horse, goat, and sheep. The animals which are of vast importance in the tuberculosis problem—cattle and pigs—are easily infected, and as their products are used extensively for human food it is of the highest importance to prevent, if possible, the disease in these animals.

The problem of tuberculosis in cattle is not only of vast importance to the stock-breeder from its economic aspect, but of still greater importance to the nation, on account of the large amount of the disease which is directly conveyed to humans from drinking milk from tuberculous dairy cows.

It is estimated that a million dairy cows in this country are at present affected with tuberculosis, and of this number about 5 per cent. are affected in the udder, thus rendering their milk dangerous to children. Many thousands of children and young persons are lost every year from this cause alone, and a great many thousands are crippled for life as a result of drinking tuberculous milk.

The loss to the owners of tuberculous cattle is enormous, amounting in some countries to millions of pounds a year.

For these reasons it is imperative to do all that lies in our power to eradicate tuberculosis from dairy cattle, if we are to prevent a never-ending supply of tuberculosis from animals to man.

Practically all calves are born healthy and quite free from tuberculosis, and that they are all infected by contact in the stalls or from being fed on milk from a tuberculous cow. This infection generally takes place in the first six months.

The only cause of the disease is the tubercle bacillus, which exists in nature in three distinct types, all originally of a common species: (1) *Typus humanus*; (2) *T. bovinus*; (3) avian type.

The *human* type causes pulmonary tuberculosis in man, and is only conveyed with difficulty to animals.

The *bovine* type attacks cattle, pigs, and horses, very rarely sheep, goats, or dogs.

The *avian* type attacks poultry, birds, and fishes, and occasionally pigs.

The avian bacillus has not generally been considered as pathogenic to man or animals, but it is now beyond doubt that if chickens infected with avian tuberculosis are kept on a farm with cattle they may infect both cattle and pigs; consequently, in Denmark in many districts it is forbidden to keep poultry, cattle, and pigs on the same farm.

I cannot see that we can ever hope to prevent infection in many of our cowsheds, as if one infected animal is introduced into a healthy herd it may quickly infect the whole herd.

In my view the only hope we have is to endeavour to immunise the calves as they are born, so as to enable them to resist the ordinary infection in their surroundings. In the VETERINARY JOURNAL of August 1921 I fully described my vaccine for the purpose of protecting animals against tuberculosis.

It is prepared from killed cultures of tubercle bacilli which have been attenuated for over sixteen years in my laboratory, and the present strains represent the 218th generation. They are quite non-virulent and non-toxic, and will not produce the disease in animals even in large doses of pure culture.

The vaccine has been used in this country for three and a half years only in large breeding herds, where it is administered by a veterinary surgeon, and where accurate observations and records can be made.

The results up to the present are most encouraging, and many veterinary surgeons have recorded the fact that they have been able to obtain a tubercle-free herd as the result of careful vaccination.

I am unable to state the length of time the immunity lasts, but it is certainly two years, and probably more. We must wait for a longer time to elapse before we can come to any final conclusions.

Method of Vaccination.—For the purpose of immunising calves, they should be separated from the mother at birth (in case she is affected) and fed on healthy milk or the pasteurised milk of the mother for a week, when the first dose of vaccine is given, followed in another week by the second dose of vaccine.

The vaccine is given hypodermically under the skin of the abdomen, with strict antiseptic precautions.

The calf is thus rendered immune to ordinary infection.

The eradication of tuberculosis is of such immense importance, both to stock-breeders and to the rising generation of children, that

it is our duty to use every possible endeavour to prevent the infection of dairy cows, and in my judgment this can only be done by endeavouring to protect the calf from being infected in the first months of life.*

THE DANGER OF TUBERCULOUS MILK.

By A. STANLEY GRIFFITH, M.D.

Report to the Medical Research Council.

(*From the Pathological Department of the Field Laboratories, University of Cambridge.*)

THERE is general agreement among medical and veterinary men that the milk of cows with clinically recognisable tuberculosis, either of the udder or of the internal organs, ought not to be used as food. Such milk is liable to contain large numbers of tubercle bacilli, and as an article of diet is a source of grave danger both to man and the domesticated mammals.

Medical opinion is, however, not unanimous upon the desirability of attempting to eliminate all tubercle bacilli from milk.

It has been suggested on purely theoretical grounds that the ingestion of small doses of living bovine tubercle bacilli in milk might protect children against serious infection from human sources.

According to this hypothesis the complete eradication of cattle tuberculosis might deprive the community of a safeguard and might lead to an increase in the ravages of the human tubercle bacillus.

I should like to point out that the results of investigating human tuberculosis lend no support to the conception that the bovine tubercle bacillus exerts so favourable an influence.

The actual figures show that the bovine tubercle bacillus is a menace to the community and a cause of suffering and death in children.

At the National Milk Conference held in London in 1922 I gave the results to that date of investigations made to determine the relative proportion of bovine to human infections in different varieties of human tuberculosis.

These investigations showed conclusively that a considerable amount of human tuberculosis is caused in this country by the bacillus of bovine tuberculosis, especially in children under five years of age.

The bovine tubercle bacillus was found in all the chief clinical varieties of tuberculosis, and in many cases of fatal general tuberculosis.

The proportion of bovine to human infections was highest in children under five years of age, and in those forms of tuberculosis

* The vaccine is prepared and carefully standardised by Messrs. Allen & Hanbury, Vere Street, London, W. 1.

which affect primarily the mucous membrane or the glands of the alimentary tract.

The age incidence and anatomical distribution of the disease clearly pointed to cow's milk as the source of infection with bovine tubercle bacilli.

Table I, which gives the percentage of cases infected with bovine tubercle bacilli (*a*) in children under five years of age and (*b*) in persons at all ages, shows at a glance the extent of the danger arising from the consumption of infected cows' milk revealed by these investigations.

TABLE I.

COMPILED FROM ROYAL COMMISSION ON TUBERCULOSIS REPORTS AND PAPERS PUBLISHED BY A. EASTWOOD AND F. AND A. S. GRIFFITH.

Variety of Tuberculosis.	Number of Cases.	Percentage of Cases Infected with Bovine Tubercle Bacilli.	
		Under 5 Years of Age.	All Ages.
			Per Cent.
Cervical gland	125	85·0 per cent. of 20 cases	48·0
Lupus	140	66·0 per cent. of 50 cases	51·0
Scrofulodermia ..	52	58·3 per cent. of 12 cases	38·4
Bone and joint ..	514	30·2 per cent. of 96 cases	19·2
Genito-urinary ..	21	—	19·0
Meningeal	12	—	16·6
Pulmonary	275	—	1·1
Post-mortem cases, children under twelve (L.G.B. series) ..	113	21·3 per cent. of 61 cases	17·6
Post-mortem cases in children under twelve years of age classified according to the anatomical distribution of the primary lesions (L.G.B. and Commission's series) showing percentage of bovine infections.			
Alimentary	35	—	80·0
Respiratory, double portal (respiratory and alimentary) and uncertain	116	—	1·8

I have continued my investigations of the subject, and during the years 1922–23–24 I have examined material from forty-five persons suffering, except in four instances, from surgical forms of tuberculosis.

The majority of these cases were under the care of Sir Henry Gauvain, to whom I am greatly indebted for his co-operation in my inquiries.

In Table II the results of the investigation of these forty-five cases are summarised.

TABLE II.

Variety of Tuberculosis.	Number of Cases.	Under 15 Years of Age.		Over 15 Years of Age.	
		Human.	Bovine.	Human.	Bovine.
Lupus and scrofulodermia . .	22	11	11	—	—
Bone and joint	13	6	4	3	—
Cervical gland	4	—	1	3	—
General	2	1	1	—	—
Meningeal	2	2	—	—	—
Kidney and testis	2	—	—	2	—
	45	20	17	8	—

The figures show that 50 per cent. of the lupus cases and 40 per cent. of the bone and joint cases were of bovine origin. It will be seen that the latter percentage is higher than in the series of bone and joint cases in Table I, but the total number of cases is small.

There was one fatal case of bovine infection, and as this was of exceptional severity, a brief account of it will be of interest.

I am indebted to Dr. J. F. Gaskell, Cambridge, for sending me the notes of the case and the material for bacteriological examination.

The patient was a girl, aged seven years, who lived on a small farm and was accustomed to drink large quantities of cows' milk. She died of general miliary tuberculosis after more than six months' illness in hospital. The autopsy showed a large tuberculous ulcer spreading from the ileo-cæcal valve a considerable way round the cæcum. In the mesentery extending from the ulcer was a chain of enlarged caseous glands. There were unusually coarse tubercles in liver, spleen, and kidneys. The lungs contained miliary tubercles throughout, and in the lower lobes there were in addition a few large greyish-red areas almost pultaceous in consistency. The tracheal and bronchial glands were not markedly enlarged. Tubercle bacilli were

extremely numerous in all the organs. A bovine culture, highly virulent for rabbits, was obtained from the liver.

Interesting features in this case were the single ulcer in the intestines (in a situation which Dr. Gaskell believes to be a common seat of primary tuberculosis in children), the chain of enlarged glands extending from this ulcer, and the extremely large numbers of tubercle bacilli in the organs.

The general infection in this case appears to have originated from a single primary focus in the intestines.

Discussion.

The view that the ingestion of small numbers of bovine tubercle bacilli in milk may be beneficial to children is apparently based on two assumptions: (1) that the bovine tubercle bacillus is less virulent for man than the human tubercle bacillus, and (2) that small doses of living bovine tubercle bacilli taken with food raise the specific resistance of individuals without producing serious disease.

In 1922 (*loc. cit.*) I gave the evidence which I think justifies the conclusion that the bovine tubercle bacillus is not intrinsically less virulent for man than the human tubercle bacillus. When a comparison was made of the post-mortem cases in which the portal of entry for the two types was the same, it was clear that the bovine tubercle bacillus produced tuberculosis, whether generalised over the body or apparently localised in one organ, in every way as severe as that caused by the human tubercle bacillus.

With regard to the second point there is no doubt that small doses of tubercle bacilli swallowed with food are less certain to infect than large doses. This fact was clearly brought out by the numerous feeding experiments of the Royal Commission on various species of animals.

While it is true that many of the children who died of bovine tuberculosis of alimentary origin owed their infection to the ingestion of large numbers of tubercle bacilli (this is indicated by the extensive lesions in the intestinal tract and mesenteric glands), there is abundant evidence that much serious and fatal disease is caused in children by small doses of bovine tubercle bacilli.

In support of this statement I will mention two fatal cases in children. They were aged two and six years respectively and both died of tuberculous meningitis. At the autopsy in each case only a minimal lesion was found in the glands of the mesentery.

In addition, there is little doubt that the vast majority of the cases of surgical tuberculosis of bovine origin were produced by small doses of tubercle bacilli, since in these cases there was clinically no evidence of disease of the alimentary tract.

CONCLUSIONS.

(1) A small dose of bovine tubercle bacilli may set up serious and fatal tuberculosis in a susceptible human being.

(2) In the present state of our milk supply the bovine tubercle bacillus causes a considerable amount of preventable disease and loss of life.

THE CONTROL OF TUBERCULOSIS AND THE MILK SUPPLY.

BY LIEUT.-COLONEL J. W. BRITTLEBANK, C.M.G., M.R.C.V.S., D.V.S.M.,
Chief Veterinary Officer, Manchester.

THE accepted fact that we are concerned with at the moment is that tuberculosis of bovines is transmissible to humans. There also appears to be much evidence that such infection from bovines is, on the whole, more virulent in type than is the infection resulting from human beings themselves.

In attempting to deal with a subject such as this, we cannot address ourselves merely to the immediate public health side of the problem. There is a very serious economic problem affecting agriculture which is of enormous dimensions, and is where the fight will have to be waged, and upon which most of the cost will fall. The total bovine population of Great Britain is somewhere in the region of 7,500,000, and of these 3,000,000 (in round figures) are cows and heifers in milk or in calf; and I think it may be safely accepted that, on the average, one-third of these would be found to be tuberculous, as ascertained by the tuberculin test. This brings us, speaking again in round figures, to the fact that 1,000,000 head of our dairy stock are tuberculous in some degree. We know, also, that many of these are so slightly affected that it makes no material difference to their well-being; indeed, it may be held that these encapsuled lesions are a source of protection to the animal concerned.

In so far as the immediate problem which we have to consider is concerned, there is much to be gleaned from the work done by certain public bodies in their efforts to control tuberculosis in milk. Most authorities of any magnitude concerned with this branch of their Public Health work have taken advantage of similar powers to those possessed originally by Manchester and Liverpool. These powers confer the right, after samples from the source of production have been proved to contain tuberculous infection, to visit and examine the cattle with a view to ascertaining the source of infection, the presumption upon which the work is based being that the animals

suffering from tuberculosis of the udder are those to be particularly eliminated ; and so far as my experience is concerned, I am of opinion that such a conclusion is correct. There are on record, however, the observations of a few independent investigators who are not satisfied that, so far as the protection of the milk supply is concerned, the main factor is that where tubercle bacilli are found in milk careful examination will show that in practically every case the source will be found to be definite tuberculosis of the mammary glands. Tuberculosis of the udder is, however, for all practical purposes, invariably a secondary condition to lesions of a primary character situated either in the thorax or abdomen, and therefore, whether the bacilli found in milk are derived from a definitely infected udder, or merely at times escape by that path, it is clear that measures limited to merely removing the active producer of tuberculous milk will achieve little in the reduction of bovine tuberculosis and permanently freeing the milk supply from this risk. The figures which I submit, and which have been carefully compiled and relate to a continuous period of twenty-three years, show that 9·88 per cent. of the mixed milk samples examined were found to cause tuberculosis, and a more detailed examination of these figures will show that the percentage found sending tuberculous milk in 1923 was higher than in 1901, my first year in Manchester.

On the face of these results it may be concluded that the work done was of slight, if any, value. This would, however, be a long way from actual fact, for on totalling my results I find that on approximately 800 farms found sending tuberculous milk, 587 cows were found suffering from tuberculosis of the udder and were removed from the milk supply. In so far as the remaining 200 or so farms are concerned, where no cow was found producing tuberculous milk, there is an almost constant history that certain cows had been disposed of prior to the visit of the inspecting officer, but subsequent to the taking of the initial mixed sample.

A large percentage of the cows found were producing considerable quantities of milk, and many were at the height of their lactation period, so that if nothing else had been done, it was something considerable to have cut such an amount of infection out of supply.

It is certain that such piecemeal measures as it has been possible to utilise have done nothing to reduce the general incidence of bovine tuberculosis in our milking herds, but then I do not imagine that anyone thought the operation of the milk clauses would have any such effect. These clauses can only have been regarded as preliminary, and it was hoped by far-seeing administrators that they would prove useful to demonstrate the true position of affairs, and that

such special experience might provide a sound basis for further legislation of a progressive character.

Many of us hoped, I think, that we should be able to achieve a good deal by inducing farmers to eliminate tuberculosis from their herds to so secure a gradually increasing quantity of milk from such sources as would have a material effect upon the amount of milk in circulation, but it has to be admitted that here we signally failed. The basic reasons for such lack of success need not be here discussed.

On the other hand, the milk clauses may have been a positive hindrance to general progressive measures in that the mere existence of such restricted powers as the clauses provided tended to lull the health service generally into a false sense of security. For many years the dairy farmers resisted strenuously everything that was done to try and secure a reduction in the number of cows producing tuberculous milk. Generally speaking, they as a class have been unable to appreciate preventive medicine. They are accustomed to regard the losses they incur as being irrevocably an incubus on their calling, and, living isolated as they largely do, their outlook is narrowed accordingly to regard anything progressive with suspicion. They also ask what extra price they are going to receive for the extra work involved in carrying out the recommendations made to them, and it must be confessed that under the system which has grown up in this country, where, generally speaking, all milk produced is regarded commercially as of one quality, it is very difficult to convince a farmer that he is not right. We know, too, despite the many statements to the contrary, that a large majority of the general public will only buy the cheapest milk which is in the market, a fact which will probably hold good in any country.

What, then, are we to suggest in the light of our experience is the correct course to pursue ?

We have one school which demands that tuberculosis shall be eliminated by drastic measures, in which the wholesale testing of cows with tuberculin is to be the sheet anchor. Here I am bound to confess that in the earlier years of my experience I was an avowed advocate of this method ; but let us see what we have to face. I have pointed out earlier on that it is safe to estimate that not less than 1,000,000 of our dairy stock will react to tuberculin, and that they are all, therefore, potential producers of tuberculous milk.

In the first place it may be well to inquire briefly why one of three animals concerned is infected with tuberculosis. There can be no reason to suppose that the question differs in any way from the same question in human medicine. Bad housing, improper food, lack of sunlight, overwork, overcrowding, and dirt all render animals

highly susceptible, and these, with infection ever present, in either the food or dwelling or both, may be cited as the principal factors encouraging the work of the tubercle bacillus.

At what early stage in the milk-producing industry will it be possible to get rid of these conditions, or, indeed, any of them? I have only to refer to housing to illustrate the magnitude of the elements which may be regarded as essential to any campaign of total eradication by such drastic measures as may be in the minds of some. But even supposing that the housing conditions were good and many of the other conditions I have mentioned were absent, I still believe that any such proposal is economically unsound, for almost inevitably the earliest animals to react to tuberculin, and those which work hardest, or, in other words, produce most milk, and cows which are of the utmost value for breeding would be condemned to slaughter. It is a practical and admitted impossibility to practise isolation on such a wholesale scale as would be demanded. The work done by Bang in this respect will amply repay close examination. Successful elimination has been done in a number of isolated instances, and these apply chiefly to single herds which had, in most cases, been selected as suitable or exceptionable, and those who have had intimate experience with work of this character will be able to contribute materially to the discussion on this point.

My own experience has been a fairly lengthy one, and it may be briefly summed up thus: that given ample accommodation, plenty of money, and the right individual, it is a certainty that reasonable success can be commanded; but it requires indefatigable industry and ceaseless vigilance on the part of the veterinary surgeon responsible, and even then many setbacks and rebuffs must be expected.

My most successful piece of work was done in connection with a special farm selected to supply certain institutions in the City of Manchester, and it is perhaps unnecessary to go into detail through the early stages of the work; it is sufficient to indicate that, however thorough our methods were, no real success attended our efforts until thorough disinfection of all the premises concerned had been carried out. In three years a herd had been established which could be described as being free from tuberculosis; but for some little time, at every re-testing, which was done every six months—I may add most thoroughly done—a few cows were found to react, and these were mostly animals which had been bought in and had passed the test once. We then decided that the only way to real success appeared to be to dispense with the purchase of recruits from outside sources and to breed our own.

This we proceeded to do, and the work in itself provided a very interesting series of facts which are not, however, pertinent at the moment to the question. We took, however, the most elaborate care in every stage in our proceedings, and the net result was that in a few years the milking herd, averaging from 100 to 110 in number, became self-supporting, and it is interesting to record that so thorough were our precautions (approaching as nearly as possible, in fact, to laboratory conditions) that in 257 calves reared we had no single case of tuberculosis as ascertained by the tuberculin test. This, then, was the state of affairs in May 1914 :—

(1) A tuberculosis-free herd had been secured.
(2) The care and selection in breeding had been so successful as to raise the annual average output of milk per cow by nearly 200 gallons.
(3) Much interesting information as to cost and feeding had been compiled.
(4) There was an undoubted gain in the freedom from conditions such as pneumonia, and we were not troubled with contagious abortion.

In August 1914, owing to some differences of opinion on the Continent, other spheres of activity were found for us, but before I left I had several chats with the farmer—a gentleman, I may say, of exceptional intelligence and resource—as to the best methods of procedure during my absence, which I, of course, hoped would only be short. Unfortunately, however, he soon found himself without veterinary aid, and was thrown upon his own resources, but corresponded with me regularly. Such, however, was his experience that I had no fear he would be able to carry on. Tuberculin was supplied to him, and as far as he was able he followed out the same procedure as he had seen me carry out. Some time later, in 1916, I received a letter from the Medical Officer of Health informing me that three samples of mixed milk supplied from the farm had been found to cause tuberculosis in the guinea-pig. I obtained leave as soon as I could and proceeded to the farm. Here I found a most disastrous state of affairs.' Clinical examination alone showed two cows suffering from tuberculosis of the udder, and the herd, save for a very few composed of the animals bred on the place, when tested with tuberculin reacted to the extent of 37·5 per cent. What, then, could be the explanation of such a disastrous state of affairs ? There is no reason to think that anything went wrong up to the end of 1915, but at this time it was found to be impossible to exercise the same scrupulous care as had been the rule heretofore. Some of the

heifers were moved to another farm, and in addition, owing to other circumstances, it was found necessary to bring in a few animals from outside the stock—seven in all, to be precise. These were carefully tested by the farmer and selected as having passed the test.

One of these recruits from outside sources I found at my examination to have tuberculosis of the udder and advanced pulmonary tuberculosis, and the other animal suffering from tuberculosis of the udder was a young cow bred on the farm and barely three years old. The regular and systematic disinfection had gone by the board, and much of the work done in this respect was unsatisfactory.

The lesson to be learned here is, I think, in confirmation of much previous experience—that even a small amount of infection let loose among unprotected or unimmunised animals is disastrous. On the other hand, to those protagonists of clearance by drastic methods, I am tempted to read an extract from my Annual Report of 1909, and to ask at the end of it what chance there is of getting rid of tuberculosis in conditions such as prevail there, for they do still prevail, as I have taken the trouble to visit within the past few days many of the farms concerned in the inquiry. They do not send milk to Manchester, but they remain in exactly the same condition as I found them in 1909, and they are by no means peculiar to the districts concerned.

"It is only possible in a limited space such as is at my disposal to refer briefly to this piece of work, which was of considerable magnitude, and having been carried out in the summer months, the general conditions prevailing at the farms were, or should have been, at their best; the results obtained are therefore all the more striking.

"The summarised results of this piece of work are as follows: The total number of farms visited was 136; of this number I found 6 to be clean, 52 were fairly clean, and 78 were dirty.

"At 5 farms out of the gross total of 136 farms there was satisfactory provision for the storage of manure. At 12 other farms the provision made was of a less satisfactory character, but was nevertheless fairly good, while on the remaining 116 farms the manure stead was either entirely absent or quite unsatisfactory.

"The total number of cowsheds inspected was 343; of these 10 were clean, 147 fairly clean, and the remainder dirty.

"I should here state that the standard of cleanliness expected was not such as might obtain in a well-kept dwelling-house, but such as might reasonably be required in any farm in which a reasonable amount of supervision was exercised. The figures are then all the more striking.

"The lighting of 78 cowsheds was satisfactory, the remaining

265 being either badly lighted or not lighted at all; 88 cowsheds were sufficiently ventilated, the remaining 255 being badly ventilated.

"The drainage of 151 cowsheds was satisfactory, while in 192 cowsheds it was not.

"In 201 cowsheds the cubic area per cow was sufficient; in 142 it was inadequate. This is somewhat contrary to usual inspection results, and while it was found that the housing was very bad, there was little overcrowding.

"Finally, the total number of cows examined was 3,019. The total number of cows found to be suffering from tuberculosis of the udder was 11. Of these, 7 were proved by bacteriological examination. Two were 'dry' cows, in which the diagnosis was confirmed by post-mortem examination. An additional 2 cows were found to be suffering from undoubted tuberculosis of the udder, but no material being obtainable, the diagnosis was not bacteriologically confirmed. In one of these cases a post-mortem examination was subsequently carried out, and ample evidence of marked tuberculosis was found.

"The number of cows suffering from tuberculosis of the udder found in this piece of inspection was comparatively small, but this is to a great extent accounted for by the fact that as soon as it became known that the farms were being visited large numbers of suspected animals were sent into the local auction market every week, and disposed of to individuals who evidently had no difficulty in disposing of this class of cattle.

"The chief purchasers of these emaciated animals were four individuals who were quite well known. Prices for actual 'wasters' ranged from 10s. to 35s.; in addition, there was a brisk trade in worn-out old cows at prices ranging from £2 10s. to £5 each.

"On a certain Wednesday morning I watched the business carried on by one auctioneer, and took careful note of the first 17 animals sold. Of these, 14 were certainly suffering from advanced tuberculosis, 9 of them having undoubted disease of the udder. A fortnight later, of the first 15 animals sold, 11 were undoubtedly tuberculous, 6 having marked tuberculosis of the udder. This is only what I saw in one auctioneer's section of the market. I should also say that what I have described took place at some considerable distance from Manchester, but it emphasises one of the points in connection with the suppression of the 'slink' trade, which is extremely difficult to control so long as such animals are admitted into markets and fairs without hindrance or comment. No hardship would be inflicted if such creatures, many of which can only be

brought to auction by cart and others arriving in a state of exhaustion, were peremptorily seized and condemned to slaughter by the nearest 'knacker.'

"There can be no doubt that if the inspection only resulted in the expulsion of the diseased animals from the herds, a certain amount of good would be done.

"Wholesale inspections of the above character should be carried out as far as possible in the winter months, when the cattle are housed and it is possible to see what are the actual conditions under which the cattle are living during those periods of the year when they are not at liberty. It would be possible then also to examine a much larger number in a day."

My conclusions are:—

(1) That at the moment the incidence rate of bovine tuberculosis is too great to justify immediate eradication by tuberculin testing.

(2) Many cows react to tuberculin which are never a serious danger to the milk supply.

(3) Tuberculin testing applied on a wholesale scale will soon become careless.

(4) Direct efforts must be made to improve, on inexpensive lines, housing throughout the country.

(5) Systematic disinfection of all cow-houses at reasonably short intervals to destroy much of the great amount of available infection.

(6) General quarterly inspection of all dairy herds by veterinary surgeons.

Note.—Such inspections to be in the hands of experienced men with special "refresher" training. The personnel of this service should consist largely of practitioners working in conjunction with experienced whole-time administrative and consultative veterinary officers.

(7) The reintroduction of the Tuberculosis Order, so amended as to exclude payment of compensation for emaciated animals. The keeping of such animals on a farm should be made an indictable offence.

TUBERCULOSIS AND THE MILK SUPPLY FROM THE POINT OF VIEW OF THE CONSUMER.

By JOHN ROBERTSON, C.M.G., O.B.E., M.D., B.Sc.,
Medical Officer of Health, Birmingham.

THE subject of tuberculosis in the milk supply divides itself very naturally into two very widely different problems, each of which, however, reacts on the other.

(1) There is the stock-owner's problem, i.e. the need for the reduction of tuberculosis in bovines in order to improve the herd and avoid loss from disease and wasting.

(2) This for me is the more important aspect—the part played by milk, and to a lesser extent butter, in producing tuberculosis in the human subject.

I desire, therefore, to deal only with the human problem, but, in doing so, one is bound to touch on some aspects of the stock-owners' case.

There exists in this country and abroad a certain limited amount of medical opinion based on theoretical consideration to the effect that a few living tubercle bacilli in milk are desirable. These theorists say that while it is true that bovine tubercle bacilli in some cases produce a deadly disease in children, and also that this disease maims others for life, yet, on the whole, these few tubercle bacilli immunise the majority of the population to such an extent as not only to reduce the number of cases due to the bovine bacilli, but, what is vastly more important, to reduce the number of patients who might become infected from bacteria of the human variety.

If such a theory be correct, all our work in attempting to obtain a milk supply which is free from infection is of little assistance in our fight against tuberculosis in man. It is, therefore, very important to examine the data on which this statement is made.

In the first place there is abundant evidence that tubercle-infected milk may give rise to tuberculosis in children. I believe that this is not in dispute, although it is impossible to make such an experiment on children direct with bovine tubercle bacilli. This theory is based on the suggestion that while milk may kill a few, the same milk immunises a great many.

It is very unfortunate that no direct evidence is easily available in all cases as to the source of infection. A child infected to-day may not show any symptoms of the disease for many months, and it is then impossible to say that the milk he consumed was tubercle-infected, and because of this lack of evidence the British public do not regard the damage done by milk as important.

It will be remembered that it is only a few years since human pulmonary tuberculosis was regarded as a constitutional disease and not as an infectious one. This is another instance of the difficulty of getting direct proof, yet if we study the question of how tuberculosis is spread among non-infected herds of cattle or in non-infected groups of people, there emerges the most abundant evidence that in every-day life tuberculosis in all its forms is developed from infection from a pre-existing case, be it bovine, animal, or human being. If the

public, therefore, could get the direct evidence of the infecting ability of milk, we should not have to wait until these medical men have had a chance of examining the subject and coming to the conclusion that milk infected with tubercle bacilli kills some and maims others.

Animal experiments do not impress the public. All the conservative part of the medical profession do not attach the importance they should to animal experiments because they have never had the opportunity of seeing or handling these experiments themselves.

The epoch-making experiments of the Royal Commission on Tuberculosis did not impress the public or the medical profession. It is now well known that the Royal Commission found two main varieties of tubercle bacilli, the bovine and the human, and that in most instances the characters of these two groups are sufficiently definite to distinguish them. But there was an important intermediate group of bacilli which it was impossible to refer to the bovine or human variety. That is to say, that with the most experienced and capable experimenters in the world there still remains a very indefinite line of demarcation between the two groups.

Personally, I have never had any doubt as to the amount of damage done to children, because I have had the opportunity of studying the problem of tuberculosis during many years, both from its clinical and pathological aspect, in human beings and bovines. I had, too, a great advantage for many years in the opportunity of carrying out experimental tests on animals.

Dr. Griffiths admirably summarised the evidence as to the damage to man from bovine tubercle bacilli in a paper which he read at the recent Milk Conference at the Guildhall, London.

I happen, also, to receive the notifications of non-pulmonary tuberculosis (largely of bovine origin) among a population of about a million people. If only a small portion of this number is due to bovine infection from milk, then it is our duty to prevent it by every means in our power. Some of these cases, e.g. of meningitis (tubercular origin), are incurable, many others cause life-long crippling, while the major portion of this group are comparatively trivial illnesses so far as crippling and disfigurement are concerned.

But is there any evidence that small doses of bovine bacilli immunise the general population against the more virulent human bacilli? As a result of a very long experience in the treatment of human beings by immunity methods, one comes to the conclusion that no method yet has been found out which produces a real good immunity against tuberculosis.

Work has been done on this subject for the past thirty-five years, and yet I think that no satisfactory immunising material, toxin or

emulsion, has been found. I believe, therefore, that we have no right to consider that bovine bacilli in milk can produce any substantial immunity.

There is another very important point, and that is that human tuberculosis has been declining over a long number of years, and that recently the decline has been more rapid than formerly, yet none of us can maintain that this decline in human tuberculosis is in any way due to a larger number of tubercle bacilli in milk immunising the people. There is no doubt that the resistance of various individuals to tuberculosis is greater in some than in others. Our experience among human beings is that this resistance is partly of an inborn character and partly due to the general healthy conditions of the individual, and is in no way due to the fact that the individual has had milk from tubercular cows.

I am aware that the opinions I have expressed cannot be verified by experimental evidence, but I feel that the experience one has had in all branches of tuberculosis work makes it desirable for me to say very definitely that the freeing of herds from tuberculosis will be of real and substantial value to the human subject. Anyone who has to deal with the number of deaths and with the crippling and disease caused by what are obviously tubercle bacilli of bovine origin could have no hesitation in saying that every means must be taken to eliminate this source of infection.

Our own experience here indicates that the stock-owner derives an immense amount of benefit directly and indirectly by having his herd freed from tuberculosis because, while the veterinary officer is carrying out the tuberculin tests, he is able to give advice on a number of other veterinary problems which assist the owner very greatly, and, therefore, not only is the freeing of herds from tuberculosis valuable from a human point of view, but it is of great importance to the stock-owner.

THE CONTROL OF TUBERCULOSIS AND THE MILK SUPPLY, WITH SPECIAL REFERENCE TO CERTIFIED AND GRADE A TUBERCULIN-TESTED HERDS IN BERKSHIRE.

By G. P. MALE, M.R.C.V.S.,
Reading.

ALTHOUGH the present position is bad, there are many hopeful features which perhaps have not been fully realised, the chief of which, to my mind, is the rapid increase in the number of Certified and Grade A Tuberculin-Tested Herds. Although this scheme has only been in

operation a short time, there are at the present moment 74 farms producing Certified Milk, 66 farms producing Grade A Tuberculin-Tested Milk, and a large number of Grade A herds. During the last twelve months the two first grades have so increased that they now nearly equal the whole of the three grades at the end of 1923, and I venture to say that if similar institutions to the National Institute for Research in Dairying, over which Dr. Stenhouse Williams so ably presides, could be located in every county of England, there would, in a few years, be such a diminution in the amount of tubercle bacilli in the milk and such an improvement in the quality and cleanliness that there would be little need for anxiety with regard to the milk supply of this country. Records of the early tests were taken, and it was found that considerably over 50 per cent. reacted, whereas now it would be under 5 per cent., and I think I may say that there are very few herds in the district that have not been tested, and the buildings and general hygienic conditions have been enormously improved, consequently the general health of the cows. But it was only when Dr. Williams came to Reading that an extensive campaign was instituted. He showed the importance of sterilisation of all vessels containing milk, and, what is more important, went round to the farms and instructed not only the farmers but the workers exactly how it should be done, with striking results. Clean milk competitions were instituted, prizes given to the workers, and demonstrations, until the workers took a pride and interest in the work. He proved that clean milk could be produced in old buildings with little structural alterations, and revolutionised the ideas on the subject. But what is more important, the farmers are satisfied that the eradication of tuberculosis is a sound economical proposition, as many have testified. Many of them are getting about £10 more per cow annually for their milk.

There are two main objections raised against this scheme : (1) That it increases the cost of milk to the consumer ; and (2) that the reacting cows are only distributed to other centres. Perhaps I may be allowed to deal briefly with these two points. It will be admitted that the production of the 1st Grade, i.e. Certified Milk, entails considerable expense, and that owing to this we cannot hope to have only a certain number of such herds, which will supply milk for invalids and others where the cost is not considered ; but there is no reason why Grade A Tuberculin-Tested Milk should not be used by all. If all the medical practitioners would advise it for their patients and institutions, there would be such a demand that the scheme would spread all over the country. It has been proved that the producer can get a profit if he sells it wholesale at 3d. a gallon above the ordinary price and the

retailer at 1d. a quart above the usual price, and if the keeping properties are considered it will be found cheaper for the consumer to pay this small additional amount, as there is less souring, less waste, and the milk is more appetising and nutritious.

(2) As to the second objection, I admit at present there are grounds for dissatisfaction, although in many cases the cows are isolated and fattened, and in others they are isolated and milked at another farm, yet many are sold in the open markets. But they are usually only bought by people who are *not* going in for tested herds, and who know, or have a shrewd suspicion, that they are reacting cows. So that gradually they are collected together into tuberculous herds, and the M.O.H. will know where they are and where he should be especially careful to take frequent samples of the milk for bacteriological examination. When the Tuberculosis Order comes into force many of these cows can be dealt with. It might be possible in the course of time to *entirely eliminate all reacting* cows from such a district by slaughter and compensation, as is done in America, where about a third of the United States is free from tuberculosis, though of course the methods employed there *would not be applicable to this country*.

At any rate, a few *accredited areas*, as they are called, might in time be formed where people wanting tubercle-free cows could come and replenish their stock. In fact, now there are several people who sell annually about one hundred heifers, down calving, which have been tested once, twice, or three times, and are free from tuberculosis, and there is a great demand for these animals.

It would be a great help if the Ministry would give a certificate in these cases to such *accredited herds*. *We must also insist* that a *Tuberculosis Order* shall be reintroduced without further delay; not only has this been asked for repeatedly by the veterinary and medical professions, but even by the farmers themselves and local authorities throughout the kingdom.

The plea of expense raised by the Treasury is absurd. In 1913, £60,000 was voted annually for five years, and it has been estimated that it will now cost £80,000 per annum for compensation, with perhaps an equal amount to administer the Order by the local authorities. Various estimates of the human deaths, chiefly children, due to bovine tuberculosis have been made, ranging from 3,000 to 10,000 per year, but one cannot estimate the untold suffering to thousands from non-fatal forms; and when one realises that the local authorities are responsible for sanatoria treatment for tuberculous patients, involving enormous expense, if only a proportion of these lives and this expense could be saved by the Order it would be worth it even from an economical point of view.

This does not take into consideration the elimination from the herd of those very infective cows which are a menace to all the healthy ones in the herd. The disease, from my own observations, is far more contagious among bovines than among human beings; one or two cows can infect a whole herd very quickly, and very few cows appear to have any immunity from the disease.* I have found as many as 98 per cent. affected in a herd kept under the best possible conditions, and in one herd, chiefly of young cows, numbering about one hundred and fifty, 87 per cent. were affected. Also, owing to the short life of the cow, I am convinced that very few recover. The loss from carcasses of cattle and pigs condemned for tuberculosis must amount to many thousands annually. In Edinburgh alone it amounts to £5,000 per annum, and the saving under this head would be very considerable.

The cost, then, of this Order would be trivial compared to its benefits.

During the short period, about twelve months, while the 1913 Tuberculosis Order was in operation, 8,073 diseased animals were dealt with in Great Britain, and of these 16 per cent. of the English cases and 29 per cent. of the Scotch cases were giving tubercle bacilli in the milk, i.e. about 1,500 tuberculosis milk samples were traced to their sources and the cows slaughtered, which is a great record.

Also, nearly 8,000 premises were visited and the cows inspected, which from an educational standpoint would be very beneficial.

I was one of those that helped to carry out the Order, and can speak to its utility, so much so that I should like to see all cows inspected at regular intervals by a veterinary surgeon, not only to find clinical cases of advanced tuberculosis, but also to report on conditions likely to injuriously affect the milk. This could easily be arranged for under Orders in connection with the Milk and Dairies Bill.

One must educate the man on the spot and show him not only how to obtain a pure milk supply, but how he can do it profitably to himself. The British farmer will not be coerced, but he can be led.

Advances have also been made in other directions. The Ministry of Agriculture has started a scheme for giving immunity to bovines on the lines suggested by Calmette and others by inoculating them as calves, and then annually with attenuated living cultures of the tubercle bacillus. Dr. Nathan Raw is also working on dead cultures and others, but time will not permit me to discuss these methods, which at present are in the experimental stages, but they offer good

* Only last week I found one tuberculous cow introduced into a herd had infected every other cow in it, though six months previously they all passed the test.

hopes of so increasing the resisting power of bovines that they may in time eliminate the disease. The great objection to some of these methods is that the animals react to the tuberculin test, so that it will be very difficult to say whether they have a natural infection or not.

The Milk and Dairies Act, when introduced, will be of great assistance, as it will enable more samples to be taken of the milk, so that infected milk may be traced to its source and the diseased animal dealt with. In this work there must be a close co-operation of the M.O.H. and the veterinary inspector; each have very important work to do, and it is by the hearty goodwill of both that the working of the Act will be made successful.

To sum up, I would urge—

1. To encourage in every way possible the production of one of the Special Grades of Milk, particularly the Grade A Tuberculin-Tested Milk.
2. The regular inspection of all milch cows at least every three months.
3. The immediate reintroduction of the Tuberculosis Order.

If these are carried out it will, I earnestly believe, go a long way towards the solution of this very pressing and difficult problem.

TUBERCULOSIS AND THE MILK SUPPLY.*

By R. STENHOUSE WILLIAMS, M.B., D.Sc., etc.

The National Institute for Research in Dairying, University College, Reading.

The last of these meetings was to me a very depressing experience, for one was left with the impression that such a thing as a clean cow was unknown in Great Britain; yet on the afternoon of that very day I had been taking visitors round to see the work that is being carried out on some of the dairy farms in Berkshire. Let me try to tell you what we saw. The cowsheds were airy and well lighted, as one visitor said to me, "one thing which strikes us is the absence of cowbyre smell." The cows were washed, the milkers then changed their coats and washed their hands. They took up their sterilised covered milking pails and clean milking stools—some farmers even sterilise their milking stools along with the rest of their apparatus—and proceeded to milk. The milk was then poured into a sterilised container, and thence over a sterile cooler into a churn which had also been sterilised. The churn lid, which was of the unventilated type, was then put on and sealed, and the churn was then taken away

* A paper read by R. Stenhouse Williams at the adjourned meeting of the Royal Society of Medicine to discuss this problem, February 1925.

to the dealer's premises. A visit to these premises revealed the fact that once again the same care in washing and sterilising everything which comes in contact with the milk was taken, until the final product, in a sterile bottle and marked with the official seal, is put upon your table.

Such is the milk from tuberculin-tested cows which has been coming to my house for more than three years. It is always yesterday's milk, and reaches me at seven o'clock in the morning. I get no further supply at any season of the year until the same hour on the following day, and I am still waiting for a sour sample. I pay one penny a quart more than the ordinary price. I have already said that milk of this character was first put upon the market in Reading in the early part of 1922. In its early days not more than a few pints were sold; it now forms about one-sixth to one-seventh of the total milk supply of the town. It is provided to our Welfare Centres, hospitals and schools and the hostels of University College, Reading. It is also to be found in many of the smaller towns in Berkshire. It is purchased by the poor in quantities at least equal to those which are consumed by those with greater means. It is not confined to Reading; last year some seven hundred gallons a day were going into Newcastle, and it is gradually finding its way into London. At the present time it forms the supply of St. Bartholomew's Hospital, and retailers in increasing numbers are putting such milk upon the market.

This milk you owe to the initiation and imagination of a few tenant farmers who, in the days of the war, tested their herds and, aided by the staff of the National Institute for Research in Dairying, set themselves to learn the true methods for the proper handling of milk—a problem by no means so easy as is generally believed, since it involves the adaptation of the technique of the operating theatre to the needs of the cowshed and its faithful fulfilment at least twice a day, seven days a week, at all seasons of the year, in the dark hours of a winter's morning as well as in the warm sun of a summer's afternoon.

This work they accomplished, and then, mark what happened: there was no demand for their milk. They were, therefore, compelled themselves to create that demand. This they did, though it was work entirely outside their province, with results, some of which I have already mentioned to you. If every doctor in the country really believed that the best form of milk supply was a tubercle-free fresh milk at a reasonable price, and put his belief into practice, rapid strides could soon be made, for the farmer is finding out that the tuberculin test is of great value to him in freeing his herd from

disease, and that the new methods of handling milk create a new mentality in the cowshed, which is not only of value in the immediate work concerned, but also improves the quality of the labour in every other direction. Certainly I do not know of a single farmer who, having once taken up the production of clean milk from tested cows, has reverted to the old ways.

A little while ago I was reading some essays by Sir Frederick Treves, in which he described his experiences as a student in the London hospitals. It was not an impressive picture which he drew of himself, passing from one bed to the next with a sponge and a bowl of water to clean the wounds of the patients. The adaptation of the work of Pasteur to the needs of the hospital has completely revolutionised the surgery of our day. Until quite recently there was no institution set apart to carry out such adaptation to the needs of the dairy farmer. Such an institution now exists, and its staff works continuously at these and other problems. It is working on behalf of the dairy farmer and is able to carry its results down into the cowshed. It is also working within the industry, an absolute essential if success is to be attained. Those of us who are engaged in this work realise how great is the change which has taken place within the last few years, and have no doubt of ultimate success, but we need your help, for there are manifold difficulties. These must be overcome before milk of the character I have discussed can be made general throughout the country.

Before I sit down I should like to be allowed to make two suggestions. First, that the consideration of the milk problem in any country must be adapted to the conditions of that country, since its solution depends upon many factors, among which may be mentioned the temperature conditions and times of haulage of the milk and the state of the Public Health Service. Our temperature conditions are moderate, our haulage is short, our Public Health Service is peculiarly complete. We are, therefore, very favourably situated in comparison with some countries.

Second, that the members of this Society should pay a visit to Reading and see for themselves what the dairy farmer really is doing to provide the consumer with a clean milk from tested cows. You would get a very sincere welcome.

THE SUPPRESSION OF TUBERCULOUS INFECTION.

By J. S. LLOYD, F.R.C.V.S., D.V.S.M.,
Chief Veterinary Inspector, Sheffield.

It is now well established that a considerable amount of tuberculous disease amongst infants is due to the infection caused by the

consumption of tubercle-infected milk, such milk being derived from cows suffering from tuberculosis of the udder. It is also well established that tuberculous disease in calves and pigs is also caused by the consumption of tubercle-infected milk from the same sources, but, in addition, there are cases where tuberculous disease in pigs is derived from tuberculous infection of the mammary glands of their mothers.

Suffering and death, both amongst humans and animals, would no doubt be considerably curtailed were these sources of tuberculous infection completely destroyed as soon as found. There are, however, a large number of losses occurring amongst animals due to infection from other animals affected with tuberculosis scattering tubercle bacilli by discharges from the natural orifices of their bodies. Animals so infected and infecting either children or other animals could be greatly reduced if the Government would reintroduce the Tuberculosis Order. For apparently economic reasons, the Government so far has refused to do this, but in reply to questions in Parliament, successive Presidents of the Ministry of Agriculture have said that the matter was receiving consideration. In the meantime many children and animals are becoming infected with disease, thus enduring suffering and death, and entailing, in the case of animals, considerable loss to the owners of such animals. For more than twenty years several of the largest towns in this country have been trying to reduce tuberculous infection from the milk supplied to, and consumed by, the dwellers in such towns. To discover the sources of tuberculous infection in the milk supplies, such towns have spent considerable sums of money in taking samples for biological tests and following up positive results by veterinary inspection. When the offending cows are found and slaughtered, the particular sources of infection are removed, thus tending to a small extent towards eradicating the disease, and in a similar way proving valuable to the community at large. Farmers who, under the Tuberculosis Orders of 1913–14, received compensation for cows affected with tuberculosis of the udder when discovered and slaughtered, now object to such cows being slaughtered unless compensation is paid, and there is no law compelling the owners to slaughter such cows or even to detain them on their premises, although whilst there they have to be isolated from other cows in milk whether in field or cowshed. Under Article 5, Sections 1 and 2, Milk and Dairies Act, 1922, it is illegal to sell, offer, or expose for sale milk from a cow suffering from tuberculosis of the udder, and persons so offending are liable on summary conviction for a first offence to a fine not exceeding £20, and for a second or subsequent offence to a fine not exceeding £100, or to imprisonment

with or without hard labour for a period of six months, or to both such fine and imprisonment.

Generally speaking, in the country, where farmers are supported by their Unions and Associations, such cows are almost invariably placed on the market and sold, if fit for the butcher, to be killed, when the butcher has to stand the loss if the carcasses are condemned, or, if in full milk, to be used for milking purposes in other dairies, possibly to supply the very town through which the fact of the animal being affected with tuberculosis of the udder has been discovered. To show the importance of this it is only necessary to state that in the fourteen years prior to the War, out of 435 cows discovered by the City of Sheffield only 52 were lost sight of, a percentage of 11·9, whereas in the last three years out of 228 cows discovered, 49 were lost sight of, a percentage of 21·5. In other words, after the City of Sheffield has spent an average sum of about £5 to find each cow, for the sake of the economy practised by the Government, this money may in the cases lost sight of be practically thrown away.

So far as can be seen at present, it appears that the Tuberculosis Order will be put into force on September 1st this year, when the Milk and Dairies Consolidated Act of 1915 also comes into force, it having been stated on several occasions both by Ministers of Health and Ministers of Agriculture, that the Act and Order would come into operation together. Whether the Act and Order will come into force on September 1st or will again be postponed is a matter of doubt, and whether the Order, when it comes, will be altered is also doubtful; but it is certain that the Tuberculosis Order of 1914 was a great advance upon that of 1913, the latter practically only dealing with "wasters" at 30s. a head, whereas the Order of 1914 dealt with all animals showing symptoms which made them liable to cause infection to other animals and to the milk supplies, at full market value, three-fourths of the compensation being payable by the Government.

It is to be hoped that when the Order does come into force, it will be sufficiently comprehensive to completely remove all known sources of infection to other animals and to children.

Should the vaccine treatment for calves now being discussed and tested prove beneficial, the disease, both amongst children and cattle, will be expected to sensibly diminish owing to the number of cows giving tuberculous milk being reduced, whilst the amount of compensation will also be reduced owing to a smaller number of animals becoming dangerous to other cattle through "open" lesions or becoming "wasters."

A WARNING NOTE ON THE CONTROL OF TUBERCULOSIS AND THE MILK SUPPLY.

By PROFESSOR J. LYLE CUMMINS, M.D., C.M.G.
President of the King Edward VII Welsh National Memorial Association, Cardiff.

SPEAKING as a student of tuberculosis, I feel that discussions on the questions of the infection of man by tuberculous milk are fraught with some danger if carried out in public, since the opinion of specialists is still divided on several important points. While I am definitely convinced of the reality and importance of the partial immunisation of human beings against pulmonary tuberculosis as a result of the ingestion of small numbers of bovine tubercle bacilli in milk, and while I regard this as one of the causes underlying the favourable alteration in the clinical type and in the death-rate from human tuberculosis noted in recent years, I feel that these considerations, important though they might be, are not an adequate reply to the tragic fact that many children are suffering permanent crippledom and a deterioration of all their vital hopes as the direct result of a preventable infection through contaminated milk.

It appears that although tubercle-free herds are a practical possibility and have actually been brought into being on a relatively large scale, the fact remains that their freedom from tuberculous disease has only been attained as the result of a very considerable expenditure of money, skill, and attention to detail; and it has been clearly shown that the cattle in such herds are extremely liable to contract tuberculosis if exposed to infection through any breakdown in the elaborate arrangements made to isolate them from other stock. I doubt whether the solution of the milk problem in the case of a relatively poor and over-taxed nation will ever be found in the wholesale organisation of tubercle-free herds.

While much more might be accomplished than at present by amended legislation and the awakening of interest in the matter amongst the farming classes and the middlemen, I feel obliged to express the opinion that the only safe solution of the question lies in the pasteurisation of milk. I lay considerable stress on the importance of quantitative factors in the spread of bovine infection to man, and hold that the mixing of milks is a great safeguard in so far as it dilutes the tubercle bacilli in the infected milks and ensures that the number of bacilli in a given volume as supplied to the consumer is greatly reduced.

I recall the experiments of many competent observers, showing that it requires relatively large doses of virulent tubercle bacilli to bring about progressive infection through the alimentary tract.

In conclusion, I strongly advocate a closer co-operation between the medical and veterinary professions, with a view to getting down to agreed facts on all these questions of bovine tuberculosis in their relationship to man.

TUBERCULOUS MILK.

By E. J. BURNDRED, M.C., D.V.H.,
Veterinary Inspector Public Health Office, Blackburn.

It is often found when following up a mixed milk which has been positive to the guinea-pig that an examination of the herd supplying the milk fails to reveal any cow or cows showing evidence of tuberculosis of the udder, in spite of the fact that the herd is unchanged. Within the last year I have had two such cases, and the results seemed to show definitely the reason. Samples of milk are taken monthly for inoculation into guinea-pigs. In the first case the May sample was returned as tubercular, but before the result of the examination was received the June mixed sample was taken. In each case the milk was the mixed milk of the whole herd. An examination of the herd following the receipt of the tubercular result showed one cow, recently calved, with clinical signs of tuberculosis, but no udder lesions. A special sample of milk was taken from this cow and found to contain tubercle bacilli. The June sample of milk, which also contained the milk of this cow, was returned as free from tubercle bacilli. The cow was slaughtered and showed acute lesions of tuberculosis on the pleura and peritoneum.

In the other case the June mixed sample was tubercular. An examination of the herd was made and a special sample of milk was taken from a cow with no udder lesions, but which did not appear to be doing well, and a control sample of milk was also taken from the remainder of the herd. A mixed sample of milk taken from the entire herd was taken in July. This sample was negative, as was also the control sample, but the special sample was positive. In neither of these cases did the cow which was causing the tubercular infection of the milk, show any signs of tuberculosis of the udder, and if no special samples of milk had been taken from them, the mixed milk of the entire herds would have been considered free from tuberculosis in view of the results.

The results seem to show that in such cases there is intermittent elimination of tubercle bacilli in the milk.

TUBERCULOSIS IN RELATIONSHIP TO THE VITAMIN CONTENT OF ANIMAL DIETS.

By M. J. ROWLANDS, M.D.,
London.

THE incidence of tuberculosis amongst dairy cattle and pigs is indeed a source of great discussion at the present day, and of course it must be so for the simple reason that in the past, and I am sorry to say during the present time, we are treating symptoms instead of treating the cause; and whenever a human physician or a veterinarian falls to the old level of treating symptoms rather than treating the cause the results are always disastrous. Why then is it that tuberculosis amongst dairy cattle is on the increase? Why is it that members of both branches of the profession of medicine have not yet solved the difficulty? Anyone who was present at the various discussions which have recently taken place at the Royal Society of Medicine, as well as at the various meetings of veterinarians, must have been astounded at such variance of opinion as to the method of treating or combating this terrible condition which is so common amongst cattle.

One school is of opinion that nothing but the slaughter policy of all animals re-acting to the tuberculin test is the only hope. Another school is of opinion that only those animals showing signs of diseased udders with tubercular infection need to be slaughtered. Others state that the slaughter of all animals with tubercular udders and the isolation of all re-acters is the solution. Others state that after this has been done constant veterinary inspection and examination, by means of the tuberculin test, must be carried out. Let it be understood quite distinctly that these methods are not going to deal effectually with the cause of the increase and present incidence of tuberculosis amongst dairy cattle and pigs, and unless the root of the evil is tackled there will be a constant killing of dairy cattle and pigs. There will be no end to the killing or to the examinations; and if this is allowed to go on for twenty years the cost of the slaughter policy and the supervision will be such a colossal figure, and the diminution in our dairy herds will be so great, that the whole question will arise. Can we possibly go on? The answer will be No! And farmers will appeal to the medical profession, and they will succumb to the appeal, and it will be a question of once more sterilising our milk to safeguard ourselves against tubercular infection. That can be the only possible ending of the procedures that are suggested by members of both professions to-day. However, there is no need to be so depressed as this, as it is quite possible to free our herds from tuberculosis by treating the cause rather than treating symptoms.

Please let it be understood that I am in no way objecting to the above methods of trying to reduce the amount of tuberculosis. I am all in keeping with killing off re-actors, segregation, and better hygienic conditions, but I still maintain that even when this is done we are entirely in the same position (or at least we shall be in a few years) as when we started our killing policy, unless we go a step further and raise our immunity by natural methods, rather than by inoculation. I personally am a great believer in inoculation, and think it should be done either by the method adopted by Dr. Nathan Raw or Dr. Calmette's method; but what is the good of immunising an animal against specific infection when one immediately removes from its body something which is so important to keep up its immunity.

One's experience as a pathologist is rather interesting. It is no good immunising against any disease unless the body has the power of re-acting against infection when it occurs. If one takes the temperatures of animals, especially dairy cows and pigs fed in the ordinary method on farms, one finds a large number of animals during the depths of winter with surprisingly sub-normal temperatures. These are the animals that are going to have a low resistance to infection. Not only to tuberculosis, but other diseases. Just picture for one moment what the poor cow has to go through. She hardly has a two or three months' rest from lactation during a year. If one takes the Vitamin content of her milk-supply towards the end of her lactation (if it happens to be in the winter time), and then tests it on animals, one finds it deficient in Vitamins. I myself demonstrated this only a short time ago.

I had made up my mind to show my experimental animals at the recent Smithfield Fat Stock Show, but owing to the usual occurrence of foot-and-mouth disease in Kent (in which county I farm), I decided to move these animals to London a month before the Smithfield Fat Stock Show. Whilst they were on my farm they were fed with milk from my own cows, which cows had been fed on Vitamin foods; but on coming to London we had to purchase milk, which purchased milk undoubtedly came from cows that had been fed on the modern methods, those which I call margarine methods—cocoanut cake, etc. They immediately dropped in the increase of weight, so much so that I had to increase my Vitamin content to double its amount. Just think of the poor calf that is suckled on a cow fed on modern methods on food deficient in Vitamins; but as I am only allowed a short space I will conclude by stating that my experiments have entirely proved that you can eradicate tuberculosis entirely, not by segregation, not by hygienic methods, not by artificial immunisation, but by feeding animals on food known to be rich in the essential

Vitamins. By this you keep your animals at a normal temperature, you raise their natural immunity, or at least you allow them to have their natural immunity.

The chief reason why the dairy cow, much more so than the bullock, is liable to tuberculosis, is because you drain it of its Vitamin content by means of milking for such a long period. Similarly with a sow.

If one did not milk these cows for more than three or four months (which is the natural lactation period of the wild cow), and allowed Vitamin foods, there would be no tuberculosis, and I really warn both our professions not to treat symptoms, but to deal entirely with the cause.

When I read my paper at the Royal Society of Medicine it was suggested by one or two members that the disappearance of tuberculosis in my herd was due to my high protein diet. This is not true, as I have fed an equal quantity of protein, but absent in Vitamins, to my animals, with disastrous results.

The day has come when one must look at this enormous question from the point as to what is the cause of this lowered immunity to tuberculosis amongst our dairy herds and cattle; and to do this is, in my opinion, the only way in which we can combat this terrible proposition which is so serious to the medical profession as well as to the veterinarians.

THE PREVALENCE OF TUBERCULOSIS AND ITS SUPPRESSION.

By Major-General SIR JOHN MOORE, K.C.M.G., C.B., F.R.C.V.S.,
London.

I HAVE attended all the meetings arranged between medical and veterinary authorities on the subject of the prevalence of tuberculosis, the better control of the disease in our herds, and the consequent lessening of incidence of it amongst human beings. I have purposely refrained from taking part in discussion or from entering into any controversy as to methods to be pursued in reducing such incidence, preferring first to hear from those medical and veterinary officers of health how prevalence now stands and the nature of their opinions with regard to this communicable disease. Though all are in agreement as to the high rate of incidence both in human beings and in animals, there seems to be a dissimilarity of opinion as to measures of control and the efficacy thereof, the methods advocated ranging from the extreme left of stamping out by slaughter and compensation to the extreme right of prevention by vaccination, others remaining sceptical as to the possibility of eradication.

The revelations in prevalence which these authorities have put before the country—and the meetings have served more than a useful purpose in this respect—are astounding, and one is left in astonishment as to why in this presumably enlightened and advanced country of ours such a state of affairs should exist. Three million dairy cows in Great Britain, of which one million are tuberculous! 50 per cent. of the total number of cows would probably react to the tuberculin test! Ten thousand deaths in children annually from contracted tuberculosis! 10 per cent. of the milk supplied to the large town of Manchester is tuberculous! 8·7 per cent. tuberculous milk in Birmingham! Necessity for pasteurisation of 60 to 70 per cent. of milk in Birmingham! 80 per cent. of tubercular cervical glands and abdominal organs in children of bovine origin! 56 per cent. of meat condemned in abattoirs is tubercular! Surely this collective evidence is enough to fill the most apathetic with the gravest concern, and to awaken those in supreme authority to a sense of responsibility to the community, and to the most urgent necessity for removing this black stain that has been permitted to exist for too long a time. The situation is all the more lamentable when medical men are forced to confess that the surgical cervical gland tubercular lesion of bovine origin is somewhat of an advantage to the individual, as it confers an immunity against pulmonary tuberculosis of human origin. It is but poor comfort all the same to the beautiful child who has to bear the mark of the wound for the remainder of his or her days. If such be "king's evil," the practice of "touching for the evil," discontinued by His Majesty King George I in 1714, had better be re-introduced in more practical form by our Ministers of State.

To my mind, and from a practical veterinary point of view, the position is perfectly plain and the remedy comparatively easy of accomplishment. Remove the cause, and the effects will cease. The offending factor is the tuberculous cow. Obliterate the grossly infected cow, and much of the danger to human beings and to other bovines is averted. Then the disease in animals can be gradually worn down and ultimately eradicated by means of the tuberculin test. Certainly no cow affected with tuberculosis in any shape or form should be permitted to provide milk, butter, or cheese for consumption in a raw state by human beings or by any animal or fowl susceptible of the disease. The alternative is slaughter for purposes of food under special conditions which assure a certain marketable value. The responsibility, and indeed the whole procedure for the elimination of tuberculosis from our herds, rests with the veterinary profession, and with proper facilities I cannot see any particular difficulty in it. Of course, even with legislative enactments, be it

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the introduction of the Tuberculosis Order or subsequent amendments, it will require time, but it is reasonable to presume ultimate complete success, and that tuberculosis-free herds will be the rule instead of the exception. I can speak with a firm assurance of successful result on this point, having the experience of the eradication of glanders and the freedom therefrom in the largest Expeditionary Force that has ever taken the field in war. Only three times was the Force in France menaced, viz. firstly in the winter of 1915–16, when the whole of the animals of the Force, then numbering approximately 300,000, were tested with mallein and the disease cleared out; secondly, when the Portuguese troops arrived at Brest in the spring of 1917 with clinical glanders; and lastly, when one of our Divisions returned from Italy. But at no time could it be said that under our complete systematic procedure was the situation difficult to manage. Even more satisfactory was the total exclusion of epizoötic lymphangitis from our islands. If our veterinary profession can achieve these results during war, with its many loopholes, it could confidently undertake the elimination of tuberculosis from our herds in peace. It only requires the chance, and unquestionably the results would come up to expectation, given the proper machinery. At present activity is centred at the wrong end of the subject, viz. the product instead of the animal producer, the milk instead of the cow. If more use was made of the veterinary surgeon in the systematic inspection of herds, the danger of infection in milk would automatically cease. Specially would I urge the enforced inspection of dairy herds supplying our large public and secondary schools, and other large institutions of the young. Parents, who in their homes can exercise personal care, cannot always be assured that the milk supplied to their children at big schools is above suspicion. Examination of the milk by the medical officer is not enough. Inspection of the cows by the veterinary expert is the essential factor.

SHOULD THE TUBERCULIN TEST BE APPLIED TO STORE CATTLE IMPORTED INTO ENGLAND?

By H. L. TORRANCE, M.R.C.V.S., D.V.S.M.,
Veterinary Officer, Birkenhead.

The importation of store cattle to Great Britain is of very recent date, and was permitted only after the subject had been given a most searching and meticulous scrutiny. To discuss the matter here might be considered an impertinence on my part, because we are all familiar with most of the arguments for and against. It was a great controversy, political, scientific, and mercenary, and I think one can say that

the results have amply justified the action taken by the Government in permitting the importation of store cattle.

A very large number of Canadian cattle which were designated stores were slaughtered at Woodside Lairages, Birkenhead, where I had an excellent opportunity of observing, among other interesting features, the extent to which they were affected with tuberculosis. From what I had read and ascertained in conversation with veterinary surgeons from Canada on the incidence of tuberculosis in that country, I did not expect to find many affected. It is a tradition of the American that he is given to a certain amount of exaggeration, and the Canadian from propinquity has become affected in the same way in a smaller degree ; but I must say that so far as tuberculosis is concerned in imported cattle they overestimated the extent of the infection.

During the last six months of the year 1924, 11,210 Canadian store cattle were slaughtered at Woodside Lairages, Birkenhead, and only one animal, a five-year-old bullock, was found to be tuberculous, which is a very small proportion indeed.

I regret that I have not a record of the post-mortem examination, showing the distribution of the lesions, but as the carcass weighed 609 lbs., we may take it that the animal was in good condition, and as the whole carcass and offal were condemned as unfit for human food, generalised tuberculosis must have existed.

There are reasons why it is not a routine procedure in the work of meat inspection at the Lairages, Birkenhead, to incise the retio-pharyngeal, bronchial and mediastinal, hepatic, and mesenteric lymph glands of all the animals slaughtered, so that it is just possible that a few slight cases may pass unnoticed, but a carcass showing the disease to any extent is almost certain to be detected.

At present I have not the same opportunity of examining the carcasses of imported stores, but from what I have seen, and I feel convinced that they were a fair average sample, I can say confidently that to test such cattle with tuberculin would be not only unnecessary, but a waste of time and money.

One must remember that these animals are for slaughter as soon as they are fat, and a very high percentage of them are in such good condition that only a very short time is necessary to " finish " them for the butcher. That they should be well conditioned when they arrive is a matter of some importance, because the chances of becoming infected with tubercle bacilli during the process of being fattened, through being housed with our cattle over too long a period, should be considered.

The very fact that Canadian cattle are so slightly affected with tuberculosis renders them more liable to infection in this country.

Whether such occurs or not at present I am not in a position to say, because I have not seen any imported store cattle slaughtered which were fattened in this country.

If cattle were imported for breeding and milk production, then the question as to whether they should be tested with tuberculin or not would be another matter, because if a " negative reaction " to tuberculin was demanded before shipment to this country, an effort might be made to isolate them at their destination with a view to establishing herds free from tuberculosis.

But as the importation of store cattle is at present limited to animals for slaughter, and these are apparently very slightly affected with tuberculosis, I cannot see that there is any necessity to test them with tuberculin prior to shipment.

BOVINE TUBERCULOSIS IN CANADA.*

FOUR policies for the control of bovine tuberculosis have been available to the stockowner. There is no compulsion with regard to them, and action is not taken until applications are received and it is found that applicants are in a position to observe the Department's requirements in regard to sanitation and disposal of reacting animals.

The oldest policy is known as the *Supervised Herd Plan*, and is applicable to any herd, but no compensation is paid under it. Any stockowner can take advantage of it by signing an agreement with the Department to observe its requirements. These herds are tested free of charge by experienced veterinary inspectors as often as it is considered necessary, and all possible measures are taken to eradicate tuberculosis and to maintain the herds free from it. Sixty-five herds are receiving attention under this plan, the majority of them being located in the provinces of Ontario and Quebec.

The *Municipal Tuberculosis Order* was passed in the year 1914 with a view to controlling this disease in dairy herds. Municipalities, however, experienced difficulty in passing by-laws to comply with its provisions, and it was therefore necessary to amend the Order three years later to permit the sale of pasteurised milk and cream from infected and untested herds. It was soon apparent that the maintenance of infected and untested herds in municipalities prevented satisfactory progress in the control of the disease. The expenditure involved in compensation payments for reacting cattle showed a marked tendency to increase yearly instead of decreasing, and it was therefore decided in October 1923 to discontinue accepting any more municipalities for assistance under the provisions of this Order. All

* Report of the Veterinary Director-General, 1924.

municipalities which had applied for assistance, but had not been accepted when this decision was reached, were given an opportunity to take advantage of the Restricted Area Plan, but they did not do so.

During a nine-year period thirty-two municipalities were dealt with under the Municipal Tuberculosis Order; some withdrew from it after varying intervals, but others are still receiving assistance under its provisions.

The *Accredited Herd Plan* is limited to pure-bred herds, and an owner must have at least five registered cattle, one of which must be a herd sire, to take advantage of this plan. An accredited herd certificate, which is valid for one year from date of last test, is not issued unless there are at least ten registered cattle in the herd.

This is an international plan, and the regulations governing the accreditation of herds are therefore similar in this country to those in force in the United States. This arrangement facilitates the importation and exportation of fully accredited cattle between these two countries, as they are admitted to either country without special test, or detention at the boundary if accompanied by a Federal certificate declaring their fully accredited status.

Although the conditions under which a herd may be fully accredited are similar in Canada and the United States, the policies followed in connection with the acceptance of herds for accreditation are not necessarily the same.

In Canada this plan is limited to pure-bred breeding herds, and in view of the many applications received for herds containing only one or two registered cattle, it was necessary soon after the adoption of this plan to require a definite number of these animals in a herd to render it eligible for acceptance. This action was necessary in order to enable the Department to conduct this work economically and to make good progress with the limited funds available for this purpose.

It was therefore decided to accept only herds containing twelve registered animals, but this resulted in dissatisfaction on the part of the small breeder, who desired to breed up a larger herd. He was naturally anxious to eradicate the disease while his herd was small, and after further consideration it was decided to accept herds containing at least five registered cattle, including a herd sire. With a view to further assisting the small breeder, it was considered advisable to accept joint herds, provided they were located on adjoining farms. These herds are dealt with as an individual herd and they must contain between them a registered herd sire and four additional registered cattle. In view of this fact, a joint accreditation certificate is not issued until each herd is eligible for accreditation. It was further necessary, in view of the tendency of some breeders to dispose of

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their healthy animals before their herds were fully accredited, to require that there should be at least ten registered eligible cattle in the herd before accrediting it.

The number of applications for the accreditation of herds which are constantly being received indicates that this plan is a most popular one, and that it is possible under its provisions to maintain tuberculosis-free herds.

The *Restricted Area Plan* is the most recent tuberculosis eradication policy of this Branch, the regulations having been passed in December 1922. Its object is the establishment of tuberculosis-free areas, and provision is therefore made for the testing of all classes of cattle in a given territory. It is undoubtedly the most logical and economical method of dealing with this disease, as it affords an excellent opportunity for systematic and methodical work, and permits the testing of the largest number of cattle in a given period. The prompt slaughter of all reactors and the cleansing and disinfection of all infected premises also provides a clean territory for the healthy herds. These herds are further protected from infection from outside sources by cattle not being permitted to come into the area, except for immediate slaughter under certain precautions, unless they have first passed an official satisfactory tuberculin test.

Only one area has so far been dealt with under these regulations, and it is located in the Carman district in Manitoba, and comprises twenty townships. The first test of all cattle in this area, numbering 16,550 head, was completed early in April 1923, and 992 reacted or 5·57 per cent. These reactors were promptly slaughtered, and the premises on which they were located were thoroughly cleansed and disinfected. The first test cost in compensation five and a half times as much as all retests and the annual general retest of all herds in the area combined, and there is therefore every prospect that this area will soon be free from bovine tuberculosis.

Investigational Work and Special Research.

Tuberculosis.—A number of different strains of tubercle bacilli of the human, bovine, and avian types have been isolated from different species of animals, including cattle, buffalo, swine, and fowl. A comparative study is being made of the characteristics and properties of each strain and type and of their co-relationship.

A tuberculin has been prepared from avian strains of bacilli and experiments have been made in the application of the tuberculin test to fowls, resulting in satisfactory evidence that the intradermal tuberculin test for fowls affords a practical and valuable means of diagnosis.

The alarming increase of tuberculosis in swine, in spite of the reduction of bovine tuberculosis, is now known to be due, in part at least, to infection with the avian type of bacillus. Extensive outbreaks in swine have occurred on premises where the cattle were free from tuberculosis, and have been proved due to avian infection. Avian tuberculosis is of enhanced importance, therefore, and must now be considered as an important factor in swine infection, and must be taken into account in tuberculosis eradication work.

A BRIEF NOTE ON TUBERCULOSIS OF ANIMALS IN U.S.A.

By A. W. WHITEHOUSE, M.A., D.V.S., M.R.C.V.S.,
Principal of the Veterinary College, Glasgow.

It is four years since I left the United States. My own experience was gained first as a ranchman, then as a practitioner, and finally as teacher of anatomy in the Rocky Mountain States of Wyoming and Colorado, at an altitude of from 5,000 to 9,000 feet. I used to read a good deal on the tuberculosis question, and was generally cognisant of conditions over most parts of the U.S.A. There was very little tuberculosis in the West, except amongst pedigree stock; range cattle were practically free, but in some of the farming districts there was as much as 10 per cent. in dairy cattle. In the older States, such as Pennsylvania, the figures on tuberculin testing might run up to 40 per cent.

Almost every conceivable means of combating tuberculosis has been or is being tried in some part of the country. The Federal Government has control of animals or their products only when they cross or contemplate crossing a State boundary or are imported from abroad. Each State has full control of its domestic diseases; but in most States very great powers have been delegated to the municipalities, and nearly all cities are free to enact such meat and milk inspection ordinances as they please.

Perhaps an outline of the working of an inspection ordinance in a little country town in which I lived and taught may be of interest, Fort Collins, Colorado, has about 10,000 inhabitants, and an altitude of 5,000 feet. It is in a very fertile, irrigated farming district, out about three miles from the mountains, which afford open grazing and are thinly settled with ranches. Anyone wishing to sell milk in Fort Collins, or to keep a cow in the town limits for his own use, had to apply for a licence and to agree in advance to accept certain conditions. The chief of these were that his cows were to undergo an annual tuberculin test, that he was to allow reactors to be branded with a **T** on the forehead and to keep them out of the dairy. The inspector, who was also meat inspector, was a part-time Professor

at the Veterinary Department of the Agricultural College. He took samples of milk in the streets. It was required that the milk be below 50° F. in the wagon at all times of year (the ice has a thickness of between 2 and 3 feet every winter, and there is no excuse for any dairyman not having plenty), that it contain 3 per cent. butter fat, and that the bacterial count be satisfactory (I have forgotten the figures). The results were published monthly, and caused keen competition among the dairymen. The inspector would give full and free advice to any dairyman on hygienic questions, and would help him to trace down the causes of such conditions as stringy milk, etc. If necessary, the State Experiment Station, a department of the College, would investigate. The buildings and plant were inspected annually, and marked according to an official scale, these marks also being published.

This ordinance was put in force in the early part of the century, and from 10 per cent. to 12 per cent. of cows reacted; by 1912 the percentage had been reduced to 5. In that year, at my suggestion, the intradermal test was introduced as an alternative, and after a year or two was made the sole test. The results were satisfactory, and for several years before I left only two or three cows were reacting annually. The intradermal may not be any more accurate, but it does not lend itself to "plugging"; it can be done very much more cheaply and at very much less inconvenience to the owner. Much more co-operation is thus obtained, and the veterinary surgeon can render much more extensive service in a given time.

The brand on the forehead proved a very successful measure. Owing to the nearness of the open range, reactors found a good salvage value as beef cattle. If they were on the downhill road the first severe weather killed them off; if not, the free conditions were such that they were unlikely to spread infection.

The town of Fort Collins paid the meat and milk inspector $900 (less than £200) pre-war; but of course the work could not have been so successful had it not been for the presence of the Veterinary College and the Experiment Station. Taken all in all, both town and College are justly proud of having eliminated tuberculosis and kept the goodwill and co-operation of the dairymen.

THE WORKING OF THE MILK AND DAIRIES (AMENDMENT) ACT, 1922.

By J. POLLARD, M.R.C.V.S., D.V.S.M. (Vict.),
Municipal Veterinary Officer, Halifax.

It will be remembered that this was an agreed measure between the National Farmers' Union and the Government of the day to

make some improvements in the production of milk, without, as was termed, the hordes of officials necessary under the Milk and Dairies (Consolidation) Act, 1915. Experience has proved that these hopes have not been achieved. Under this Act two separate registers have to be kept, namely: one of persons carrying on the trade of retail purveyors of milk, and a separate register of persons carrying on any other trade to which the Enactment or Order relates, i.e. the Contagious Diseases (Animals) Act, 1878, Section 34, and the Dairies, Cowsheds and Milkshops Order, 1885.

According to the Dairies, Cowsheds and Milkshops Order, 1885, there are two exceptions to registration:—

(1) The cowkeeper who makes or sells butter, or cheese; or both.
(2) A person who sells milk of his own cows in small quantities to his workmen or neighbours.

The second exception should be more clearly defined, as it is subject to a great amount of elasticity in its interpretation. There is a case on record, according to Mr. Torrance, Veterinary Officer, Birkenhead, where a person sold about 8 gallons of milk daily under the plea of supplying neighbours. The local authority endeavoured to enforce registration, but were unsuccessful in the court of law. A producer who applies for registration is registered automatically, or permitted to carry on business until a visit of inspection proves premises, cows, or methods as unsatisfactory; then the inspecting official has the task of supporting his objection. I can speak from experience that it is advisable to have someone to corroborate one's evidence.

Section 2 of the Act gives power to the local authority to refuse registration of, or remove from register, retailers of milk, subject to a right of appeal against refusal or removal. Refusal or removal is only permitted if the local authority is satisfied that the public health is or is likely to be endangered by any act or default of any person who is registered or who seeks to be registered therein as a retail purveyor of milk, in relation to the quality, storage, or distribution of milk. It will be noted that wholesalers are not included —a grave omission—and it is to be hoped that this omission will be corrected at an early date. Compromises have to take place in most Acts of Parliament, and this is an excellent example. It will thus be noted that the Act allows ample safeguards for the retailer, so much so that it is possible to conceive that an obdurate person might continue selling milk for a period of twelve months after objection has been taken to his registration.

It is also possible to conceive the means by which a producer retailer, if refused registration and residing outside the area of the

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registering authority, could escape the effects of this Section, and continue to dispose of his milk without any, or at least without material, improvement which led to the refusal.

I wonder how many refusals have been made on the ground of quality? How many convictions should be recorded against a person before a local authority exercises the power under Section 2, Sub-section 2, of making application to the Court for the removal from the register of the person so convicted? That is, in addition to any other penalty.

STORAGE.

This applies not only to the place where the milk is produced; but to places where milk is stored pending distribution. Should registration be refused to a small producer who has no accommodation for the storage of milk, but states that he delivers the milk twice a day and does not retain any overnight except for personal use? I consider the practice on farms of storing milk overnight in churns by depositing them in a well with running water, providing the well is not in close proximity to some source of pollution, is satisfactory. I recollect one place where the sole accommodation for storage of milk was in the large milk churns, placed in a bath where the water at the time of visit was dirty and stagnant.

DISTRIBUTION.

The present system of distribution of milk by means of the large churns cannot be considered satisfactory. The defects will be patent to all. The practice of filling bottles in the street should be prohibited. One great defect on most farms is the lack of adequate facilities for the scalding and cleansing of churns, utensils, and bottles used in collection and distribution of the milk. Some appear to think any class of discarded vehicle is suitable for conveying the milk; also that the appearance of the churns does not count providing they do not leak. It has to be remembered that in a large number of industrial towns some people engaged at work are dependent on their milk supply from small shopkeepers, where the quantity of milk sold is not sufficient to warrant any special provisions beyond receptacles and measures.

What standard should be adopted? The law is definite that no milk should be stored in a living or a sleeping room, but is not clear on which businesses exception should be taken to. Should a greengrocer who also sells fish, or a grocer who sells paraffin oil or firelighters, be considered a suitable applicant for registration? Up to the present I am unaware of any case under the Act having been taken to the Court of Appeal. There was a case at Manchester where a retailer

appealed to the Justices (Stipendiary) against the Corporation specifying their own conditions on granting a certificate, but this was decided to be *ultra vires*. The conditions were to sell milk in bottles only, which had not to be sold in quantities less than one bottle.

Section 3 prohibits the sale of milk under any of the designations specified in the Section, or under any description including or resembling any such description or designation except with a licence, granted by the Minister of Health, or with his authority under the provisions of an Order made by him under this Act. I consider the sale of milk in bottles, except the designations prescribed in the Milk (Special Designations) Orders, should be prohibited. To charge an extra penny per pint for the simple transference of milk from the churns to the bottle—very often in the street with a disc taken loose from the pocket—is unjustifiable. The extra charge should be for the extra cost incurred in the production of the milk, not for reimbursement for the cost of bottles solely. The Council of the National Clean Milk Society have submitted to the Ministry of Health the following recommendations: It should be made illegal to use such expressions in connection with the sale of milk as "guaranteed," "nursery," "invalids," etc. The only designations permitted should be those referred to in the Milk (Special Designations) Order. Any milk offered to the public which has been pasteurised or otherwise treated by heat should be described as "pasteurised" milk or as "heated" milk.

Section 4 prohibits the addition of colouring matter, water, or any dried or condensed or skimmed milk, etc. The process is known in the trade as "toning." I am unaware that "toning" has aroused the need for any special comment in England, but according to the Report of the Inter-Departmental Committee appointed by the Scottish Board of Health, published in September 1922, this practice was specially commented on and aroused some considerable interest.

Section 5 prohibits the sale of tuberculous milk. This Section imposes the heaviest penalty under the Order, which should be enough to make any owner of cows to report abnormalities of the udder. But, unfortunately, there is a clause, if he knew, or could by the exercise of ordinary care, have ascertained that the cow was suffering from that disease. The Act places a definite responsibility on the owner or person in charge, but up to the present I have not had a solitary case of abnormality of the udder reported to me. I could understand a case occurring where a bulk sample has been reported as containing tubercle bacilli, but when search is made for the offender it is possible the culprit may not have any gross lesions of the udder. It is obvious in that case no charge could be made against

the owner. I have found cases of tuberculosis of the udder where the lesions were so flagrant that it was impossible for a person with any knowledge of cattle to overlook, yet when the same has been pointed out to them the owners have tried to excuse themselves by pleading ignorance. I will grant that it might be excusable for an owner or person in charge to say that they could not distinguish between tuberculosis of the udder and other diseases of that organ. I maintain that where some abnormality of the udder is patent, the responsibility, as Mr. Gofton, Chief Veterinary Officer, Edinburgh, has expressed it, rests on them to take such steps necessary to lead to a diagnosis.

How many convictions have been recorded under this Section? The addition of water—no matter how pure—is considered to be a graver offence than selling milk containing tubercle bacilli. It is not sufficient to find a cow affected with tuberculosis of the udder on a farm, even if that cow does give milk. One has to prove a sale of milk containing tubercle bacillus. There is no provision for "wasters" which do not show signs of tuberculosis of the udder. The Order of 1899 makes tubercular udder notifiable, and provides a penalty not exceeding £5 for failing to report. I have felt deeply grieved when I have found an advanced and chronic case of tuberculosis of the udder to think of the irreparable harm that has been done by the particular cow before it has been discovered. As Sir Berkeley Moyniham stated at a recent dinner, when giving a toast to Children's Day, it is a matter of common knowledge among us that all forms of surgical tuberculosis are due to infected milk. All children, whether rich or poor, or residing in town or country, who partake of milk containing tubercle bacilli are liable to infection.

As Sir Berkeley further stated regarding cancer, that unless there is a sort of publicity campaign in which the Press and the platform alike will have to take their share in order to educate the lay people in the secrets of the medical profession. So it is in regard to tubercle. One has only to peruse the newspapers to note how keen and aggressive some propagandists are to bring their particular subject to the notice of the public, yet the grave question of milk receives scant attention on the whole. It is difficult to understand the apathy of the Government in this matter. At least one important step would be to restore to local authorities the control of cattle known to be a source of danger to the public by the reintroduction of the Tuberculosis Order. This would prevent the sale of a cow giving tuberculous milk to another district and continuing its deadly work, or even being slaughtered and prepared for human consumption, except under supervision.

Section 8 demands the Minister of Health shall make regulations for the prevention of danger arising to public health from the importation of milk intended for sale for human consumption. Also provides for the labelling or marking of tins, etc., containing dried, condensed, skimmed, or separated milk. This section is only fair to home producers. One remembers the disadvantage they were at before this Section was introduced.

Section 9 provides for penalties. I was hoping to obtain particulars of prosecutions under this Act, but regret that I was unable to do so.

Section 12 provides as to breaches of contract—if he proves that refusal of registration or removal from register was due to the quality of milk supplied by the producer.

It will be obvious that the retailer might be the victim of circumstances with regard to quality where the fault is referable to the producer. This often happens in the course of taking samples under the Food and Drugs Acts. If a sample was purchased from a retailer who is not a producer, and that sample was found to be deficient in quality, a sample would be taken from the supply to that retailer before he accepts delivery of the same. If that sample was found to be deficient in quality, I consider that would clear the retailer.

It was stated in a letter to the Press by a prominent District Member of the National Farmers' Union that the milk producers were hounded to death by inspection. I am certain this assembly can refute that statement. As a matter of fact, too much consideration has been given to the traders in this Act.

The great defects in milk legislation are: (1) The word "may" is used instead of "shall." (2) The default of small authorities to carry out their obligations. It is absurd that regulations should be enforced on one side of the road while ignored on the other. In the case of small authorities the control should be under the County Council.

TUBERCULOSIS IN THE PIG.

By G. MAYALL, M.R.C.V.S.,
Bolton.

PERHAPS the pig next to the cow is the most frequent quadruped affected with tuberculosis. As regards its prevalence in various countries, it is stated that in America over 25,000 pigs are condemned every year (Lynch); in Germany 2 to 3 per cent. of pigs slaughtered are tuberculous, the disease being most prevalent in Saxony and

Prussia (Glässer); in Denmark and Holland, countries of intensive milk production, it is common; and in France and the United Kingdom it is by no means rare. Clinically, from outward appearances, the disease is not easy to diagnose unless it is of an acute character and develops rapidly.

How do pigs contract tuberculosis? They may be affected with the bovine, human, or avian type of bacillus. Infection in by far the greater number of cases occurs through the digestive tract, the ports of entry of the bacilli being the tonsils or small intestine. The sources of infection are the fæces of tuberculous cows and fowls and human sputum. Tuberculous milk, separator slime, clarifier sediment, may all cause tuberculosis by being fed to pigs. In rare cases infection may be through inhalation of tubercle bacilli and castration wounds, and tuberculosis of the uterus through infection by the semen of the boar has been recorded. An affected pig may soon spread the disease in a herd, and a tuberculous sow infect her litter, and a tuberculous attendant or tubercle soiled or infected food may cause the disease.

How is the disease to be diagnosed? Emaciation, dullness, weakness, and digestive troubles occur. Palpation of the abdomen may cause pain, and one may feel hard, lumpy mesenteric glands, glandular tumours may be felt round the neck or at the entrance to the chest. Pulmonary tuberculosis is evidenced by a short dry cough and spasmodic or difficult flank movements. The long bones are often affected, and swelling appears on them and movement is difficult. The vertebræ too are frequently attacked, and there may be pain evinced on pressure on the spine. In a pig meeting with an accident from a broken back, the back might not have been broken had not the pig been tuberculous.

The application of the intradermic tuberculin test is stated to be very useful in the pig. It is made in the thickness of the skin near the base of the external surface of the ear, and if the pig is tuberculous an œdematous plate about the size of a five-shilling piece with a violet-red centre forms there in less than forty-eight hours. This test, separation, isolation, and complete disinfection of the locale is the way to clear up the herd. The sterilisation of the sub-products of the dairy and the testing of cows for tuberculosis is also indicated (Moussu). Kitchen refuse which may be contaminated with human sputum should not be fed to hogs. Fowls and hogs should not mingle indiscriminately, and fowl-soiled ground should not be frequented by pigs.

TUBERCULOSIS IN THE DOG.

By G. MAYALL, M.R.C.V.S.,
Bolton.

THE consideration of tuberculosis in the dog has been somewhat overshadowed by the attention directed to the baneful tuberculous cloud spread over the bovine and porcine species.

Tuberculosis of the dog in this country cannot be regarded as common, but most veterinary surgeons with many canine patients will come across a case or two in a few years' practice. We do not get the number of cases seen in Paris, where at the Alfort School in 1890 there were forty cases diagnosed in the clinic, and in the following three years sixty-five cases, and since the end of the last century it has been estimated that 3 to 4 per cent. of dogs brought in for treatment were tuberculous (pp. 203 and 204 *Médecine et Chirurgie Canines*, Cadiot and Breton). Autumn and winter seem to be the times of year when the disease mostly declares itself. City and town dogs furnish more examples than those of the country, and house-dogs and low set dogs seem to be more prone to infection than big and out-of-door dogs. We think that this may be explained by the fact that the lungs of out-door dogs that are constantly breathing fresh air and running about get their air cells flushed out and are in better position to resist infection than the animals that are living in an atmosphere containing a deficient proportion of oxygen. Full and deep inspirations are rarely taken by house-dogs, and consequently their respiratory tract is seldom in robust order.

Again, perhaps small dogs are keener in the pursuit of garbage and old-fashioned smells, and we know that most of them live in more intimate contact with their owners (which in case either the owner or dog gets the disease is a matter of importance). Further, house-dogs and low set dogs are more apt to inhale secretion-laden dust and perhaps to lick up sputa and discharges.

How do dogs contract tuberculosis? It is probable that it may be brought about by inhalation or ingestion of both human and bovine bacilli. Ingestion would appear to be the commoner mode of infection, and in the great majority of cases the contaminating material is human sputum. And sooner or later the dog itself becomes affected with open tuberculosis and dangerous to humans and other dogs. The expectorations of a phthisical subject and food, or virulent excretions supplied from tuberculous animals, then, are the chief sources of tuberculosis in the dog.

How is the malady to be diagnosed? We think this may frequently be conjectured correctly clinically. There is depression, a look of

sadness, sunken eyes, easily tired, emaciation, weakness, cough, enlarged pharyngeal glands, vegetative tuberculosis (nodules) may be detected by the finger in the pharynx and sometimes seen on the roof of the mouth.* There is often the history of a tuberculous owner or relation of the owner. A tuberculous cow or pig may also be an object of suspicion. Bacterial examination may reveal tubercle bacilli in the discharges. The tuberculin tests may be applied. The dose for the dog is 1 to 10 centigrammes. In two-thirds of the cases a characteristic reaction occurs; the temperature rises from 1·5° to 3°; it begins from the fourth to the tenth hour, generally towards the fifth or sixth it quickly reaches its full height and persists several hours. The ophthalmic test may also be made with tuberculin or discs.

It is well to bear in mind the possibility of tuberculosis in the dog, especially where there are families of young children, and when the disease is detected, the subject ought to be unhesitatingly sacrificed.

TUBERCULAR CHOROIDITIS IN THE CAT.

By HAMILTON KIRK, M.R.C.V.S.,
London, W. 1.

In tuberculosis of the cat it is not uncommon to find inflammation of the choroid. The latter is the lining of the inner surface of the sclerotic, and extends from the optic papilla (or entry of the optic nerve) to the ora serrata. Tubercular choroiditis appears, in some cases, to be one of the earliest signs of tuberculosis, and may be observed long before the usual clinical manifestations of that disease are in evidence. Among tubercular cats it appears to be most common in the young, although adults are not by any means immune. In the majority of cases the condition is bilateral, but if only one eye is found to be affected it is generally not long before the other eye shows pathological change.

In past years I must admit to having had several cases of unaccountable feline blindness, the real nature of which was never realised until Mr. Henry Gray called my attention to the condition. That tuberculosis did, in fact, affect the choroid of cats was first proved by a series of observations undertaken in 1911 by Drs. Hancock and Coats, who issued a highly interesting and lucid report of their findings. Since that time Mr. Gray has paid close attention to the matter, and it is hoped—by this brief article—to stimulate others to a closer observance of a feline disease about which far too little is known.

* See Veterinary Journal, p. 165, May 1917.

In the light of present-day knowledge, however, it would appear that tubercular choroiditis is by far the commonest cause of blindness in cats. I have under my care, at the present time, a red tabby male cat, aged about three years, which, although a victim of this disease, shows no clinical sign whatever of tubercular lesions in any other part of its body. In fact, it seems very well in health and in good bodily condition. The temperature ranges in the neighbourhood of 101·5° to 102° F.; but it is not uncommon to find cats with a temperature of 103° to 104° F. when so affected. Sewell asserts that pyrexia is a *constant* accompaniment of the disease.

The animal under notice is absolutely blind in both eyes, being unable to appreciate moving objects even two inches away. The owner had only noticed defect of vision a fortnight before it was brought to me a short time ago. The pupils are extremely dilated, the irises being almost invisible. Strong light induces no reaction, but a 1 per cent. solution of eserine applied to one eye causes a very slight pupillary contraction. The corneæ are very clear, as also are the aqueous and vitreous chambers.

Viewed through an electric ophthalmoscope, the retinal vessels were found to be unusually numerous, engorged, and very tortuous. Owing to engorgement, it is probable that some of the finer and more invisible vessels are brought into greater prominence. Possibly adventitious vessels come into being. Three small areas of hæmorrhage were observed in the cat's right fundus, in which also slight detachment of the retina could be detected in two places.

Obscuring the brilliance of the tapetum lucidum in several places were irregular yellowish-brown areas of exudate, which, according to Nicolas, cover the small tubercles or miliary granulations situated between the choroid and sclerotic. Several observers have recorded the development of actual tubercular tumours in the choroid, invading and disorganising the eye in the same way as neoplasms of the same size. The symptoms I have described, in the red cat under discussion, are essentially those recognised as characterising tubercular choroiditis, though as time advances and the disease develops I shall expect to find changes in the media, lens, iris, and cornea, with some elevation of temperature, and probably emaciation.

In the experiments made by Hancock and Coats upon six cats, it was found on post-mortem that in two of them the choroids were the only seat of tuberculosis; in four the lungs were diseased; the kidneys were diseased in three, the nodules being in each instance large. Guinea-pigs were inoculated with material from the ocular and other lesions, and in most cases gave positive results, although the tubercle bacillus itself was not always discovered.

TUBERCULOSIS IN THE RABBIT AND GUINEA-PIG.

By HENRY GRAY, M.R.C.V.S.,
London.

SINCE rabbit-keeping for fur and wool has become a great industry, and is carried on by a very great number of people scattered all over Great Britain, more attention is being paid to the decimating maladies of this species.

To force the growth of young animals or the wool of the adults many keepers have contracted the habit of giving rabbits cows' milk. In consequence of this practice a very large number succumb to generalised tuberculosis which usually attacks every organ in the body, but more especially the mesenteric glands, spleen, liver, and lungs. The disease may be so rapid in its progress that it may kill the victim before any appreciable emaciation has had time to appear.

When the source of the disease has been pointed out to owners many of them reply that they obtained their milk from reputed dairies, and supposed the vendors had rendered it harmless before sending it out. This goes to show that all over the country milk containing tubercle bacilli is being distributed in spite of the fact that the authorities are urging dairymen and farmers to supply only pasteurised or tubercle-free milk. Until tuberculosis is freed from our herds no reliance should be placed on so-called clean milk until after it has been boiled to a degree so as to kill all germs, whether those of tuberculosis or of any other source.

What I have said concerning the rabbit applies equally as well to the guinea-pig. One often wonders when making post-mortem examination of the rabbit and guinea-pig how many of these animals used for experimental purposes are affected with tuberculosis and other infections. The same may be said of cats and dogs. How many of them contract infectious diseases which are put down to experimental *effects* when in reality they are coincidental natural infections originating by contact and have no relationship with experimental *causes*.

Translation

ANTITUBERCULOUS VACCINATION.*

By PROFESSOR G. MOUSSU.

Is the formidable problem of fortifying oneself against tuberculosis or of antituberculous vaccination on the point of being solved? One earnestly desires it, and it seems that there may be good reasons

* *Recueil de Médecine Vétérinaire*, January 15, 1925.

for believing it, when one draws a logical conclusion from varied communications made by different experimenters in the course of the past year.

M. Vallée, in a communication made to the Academy of Sciences (January 1924), apparently considers the problem solved from the scientific point of view, with the necessary reserves on the results of the transfer of the method into the domains of practice. MM. Calmette and Guérin, on the other hand, announce the actual situation of experiences in the field commenced a long time ago and followed up with a rare tenacity and sagacity.

For those who have never experimented on tuberculous humans and animals the reported results appear so exact, so logical, and so much agreed, that one must arrive at the conclusion that probably the solution has at last been found; it has besides been announced a little prematurely and by multiple echoes without any reserve. But for those who have studied much, inoculated, and experimented on tuberculosis, who have followed its evolution under the strange variants which it is sometimes possible to discover, even experimentally, doubt still exists because the attentive analysis of the facts announced do not carry conviction.

Without doubt this analysis is not made by all of us, not even by all those occupied specially with tuberculosis; it is only possible and useful for those who have experimented, and, moreover, experimented for a long time.

On what do the principles of the methods of vaccination or fortification (a new expression *fort à la mode*) which have been announced depend? On the following starting-points considered as dogmas:—

(*a*) Tuberculosis is a chronic type of malady, compatible at times during the whole of life with external appearances of health (observed facts in human pathology).

(*b*) The tuberculous carriers of a little focus *which remains latent*, which remains at rest or inactive, are the best placed to defend their organism against new invasions by tubercle bacilli (inaptitude to re-inoculation); this amounts simply to a formula used by Guérin, that in order to resist tuberculosis one must be tuberculous; but tuberculous for fun, if one could employ this expression for so grave an affection, tuberculous as little as nothing, latently tuberculous, that is to say tuberculous without being it. Those are the opinions which rest without doubt on the data of observation and experiment: from observation which has been verified in autopsies of aged subjects, having always enjoyed perfect outward health, the presence of one or several small tuberculous foci of long standing and encysted; that child carriers of scrofula for example (superficial glandular and

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cutaneous tuberculosis) rarely have pulmonary or generalised tuberculosis ; data of experimenting in which cattle reacting to tuberculin, carriers of tuberculous lesions in a state of inactivity, resist experimental bacillary infections which suffice to kill, in a given time, subjects previously recognised as perfectly healthy.

The data in question, apparently quite logical, which serve as the basis of scientific principles, do they correspond exactly to the interpretation which is given to them ? It is not absolutely demonstrated that this is so.

If it is true that scrofulous subjects generally have no pulmonary lesions, they are not and do not remain less damaged, more exposed than healthy subjects to all other morbid causes ; one does not desire to consider them as vaccinated against tuberculosis.

If old people having always been in good health are found on autopsy to be carriers of small tuberculous foci remaining latent, this does not necessarily imply that they have not died of tuberculosis thanks to this small latent focus, but perhaps quite simply thanks to their organic *milieu*, that is to say, to that which we cannot well define when speaking of constitution, of intrinsic quality, or of natural individual resistance to an infection. If tuberculous beasts having latent lesions resist better and for a longer time than healthy and young cattle to experimental inoculations of fatal doses, this doubtless points in favour of a latent focus, of weak virulence, enabling them to acquire a certain resistance which does not exist in the normal ones, but a resistance analogous to that of children damaged by scrofula, analogous only to that which is communicated with the bacillus of human type or other attenuated bacilli ; but this does not prove that *with time* infections and virulent superinfections will not progress. Is not this one of the notions running through the old experiences of control in Behring's method ?

Tuberculosis is a malady of chronic type from the first, in the majority of cases ; too often, however, it assumes an acute progress as well in the bovine as the human species, and nothing in the advance allows us to decide that the evolution will be acute, subacute, or chronic.

However it may be, from the sum of these data, well or badly interpreted, it has been deduced from them, and the opinion is established that if it was possible to create in receptive organisms a harmless artificial lesion, capable however of giving birth to a positive reaction to tuberculin, and to play the rôle of a natural latent focus of tuberculosis, the fortification, the effective resistance to tuberculous infection, would be realised without any danger.

Is the directing idea of the actual orientation of these researches totally and absolutely new ? Most certainly not, for Heymans in

Belgium and myself in France have, twenty years ago, although not by the means mentioned to-day, realised the principle of the creation of an intra-organic harmless tuberculous focus, that is to say, it was intra-organic immured in a diffusor (Heymans, " Vaccination antituberculeuse," *Archives internationales de Pharmacodynamie*, 1905–1907–1908 ; Moussu, " Société de Biologie, November 1905, et Cultures de tuberculose *in vivo* et Vaccination antituberculose," *Recueil de Méd. Vét.*, November 15–December 15, 1907).

The results have not been those hoped for by the authors, but it is doubtless not inopportune to recollect the work for the interpretation and appreciation of the deductions announced hereafter.

M. Vallée uses as virus-vaccine a tubercle bacillus of equine origin, of which he has spoken many times, of virulence so attenuated that a milligram must be used to have pathogenic effects on a guinea-pig. When it is used in emulsion in an unabsorbable excipient, constituted by oil of vaseline with the addition of porphyrised sandstone, or oil of vaseline and talc, and injected under the skin of bovines in doses of 10 to 50 milligrams, a tuberculous focus is constituted of theoretically indefinite existence since unabsorbable.

After several years one finds the inoculated tubercle bacilli at the same point of inoculation.

This artificial focus plays the rôle of substitute for a natural latent tuberculous focus and shelters the animal from reinfections, that is to say, by deduction plays the rôle of a vaccine for the duration of its existence.

It is simple, practical, elegant and effective, says the author. In the laboratory, in fact, animals thus vaccinated resist perfectly virulent experimental infection by the injection intravenously of a dose sufficient to rapidly kill the controls.

There does not appear to be any reason why events should not happen in the same way in the field, virulent experimental intravenous inoculations being always in principle much more severe and more massive than accidental contaminations even in the case of herds gravely effected.

However, it is in the publication of the author that one finds some points which give food for serious doubts in the mind of those who have some knowledge of tuberculosis inoculation. These points are as follows :—

1. On the constitution of the vaccinal tuberculous focus, M. Vallée says this : " *These (the vaccine bacilli) have proliferated in the bosom of a purely local fibro-caseous lesion, without any tendency to generalisation.*"

That some vaccine bacilli remain such or pretty nearly unabsorbable is quite conceivable; that the artificial lesion realised may be constituted by a shell of fibrous or fibro-caseous envelope enclosing the unabsorbable medium may also be imagined; but that in this medium and in this shell some bacilli *have proliferated without any tendency to generalisation* is an impossibility.

Of two things, the one is either the bacilli-vaccines remain such in an unabsorbable medium and play a protector rôle due to their presence alone; or they proliferate (which one cannot conceive biologically for a vaccine of this order). If they proliferate in the shell of the envelope, that is quite the characteristic of the tendency to extension, that is to say the first step towards generalisation, and it is an error to affirm that it constitutes a local lesion without tendency to generalisation.

For this reason alone those who have experience of tuberculous inoculations will not be able to admit the view of the author on the consequences of the anatomopathologic evolution of the lesion developed by vaccinal inoculation.

2. Concerning the resistance of the vaccinated to a virulent inoculation which they support without apparent damage, when the same dose rapidly kills controls. The comparative autopsy of controls and vaccinated has shown that: *only a few glands of the vaccinated, normal in appearance, enclose virulent bacilli.*

That is to say, at the period when the controls died, subjects considered as vaccinated had not yet destroyed or eliminated the virulent bacilli inoculated. Without doubt one can advance the view that these vaccinated subjects will in time eliminate the few bacilli imprisoned in their glands!

But to say or even to affirm is not to demonstrate, and from the moment when there are virulent bacilli which sojourn and are found again in the glands, one cannot uphold the view that all danger of ulterior evolution may be discarded.

In this case is it not exactly what happened in the famous experiences with Behrings' method? Was it not stated and acclaimed that subjects described as vaccinated had effectively resisted *in appearance* virulent tests—when they presented glands healthy in appearance but enclosing virulent bacilli? And at the time did he not take upon himself to demonstrate that all the danger and all the peril were there, and that these bacilli were responsible later on for lesions in the glands and elsewhere?

In this connection, and to defend my point of view against those who acclaim success, I recall to-day what was written at the time (G. Moussu, "Le bilan de la vaccination antituberculeuse," *Recueil*

de Méd. Vét., November 1, 1906, and *Semaine médicale*, December 5, 1906).

Why should the same things happen differently to-day from formerly? In the matter of antituberculous vaccination one must not be in a hurry if one does not wish the promises of to-day to renew the errors of the day before.

For the two fundamental reasons before indicated, the procedure of antituberculous fortification by virus-vaccine of equine origin, in an unabsorbable medium, does not therefore appear to me to merit the qualities that have been attributed to it; if by chance the future demonstrates its efficacy, I shall be very happy to proclaim my error.

The Calmette–Guérin method is quite different, it is the result of a long series of special researches on the attenuation of a virulent bacillus of bovine origin. During thirteen consecutive years, and with the help of hundreds of successive cultures, Guérin has pursued without relaxation the attenuation of bacillary virulence by cultivating and recultivating on biliated media. He has succeeded in thus obtaining a harmless bacillus for all species of animals, a bacillus avirulent and atoxic, that is to say, incapable of provoking the formation of tubercles or of manufacturing toxins.

To fix these new qualities the avirulent and atoxic bacillus has been reported in successive cultures on ordinary media where it is shown to remain avirulent, but to regain its toxigenic function, that is to say, that it is actually tuberculinigenous, but not tuberculigenous; this is the B.C.G. (bacillus-vaccine Calmette–Guérin).

This avirulent bacillus vaccine possesses therefore preeminently the fundamental property sought for in all vaccines, in that it is incapable of causing illness, i.e. bringing about tuberculous lesions; but as it can manufacture tuberculin and as a result impregnate the organism which harbours it with the toxins which it manufactures, it provokes in this organism a general defensive reaction against all possible bacillary infections. To be effective it must constitute a durable avirulent focus, making a chronic lesion tardy in absorption. It is desirable that the defensive organic antituberculous reaction ought to be permanent, prolonged at all times, and not temporary only as for ordinary vaccines against acute maladies.

Also protection is realised by a subcutaneous injection of a big dose of B.C.G. of 50 to 100 milligrams of fresh bacilli which provokes a local lesion which becomes encysted, indurated, sclerosed, takes a very long time to be absorbed and disappear, a year to eighteen months.

But it is not indicated here that the B.C.G. multiplies on the spot; on the contrary, it is destroyed by whatever mechanism with-

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out doubt badly determined, or eliminated by the natural emunctories, since in time the primitive vaccinal lesion declines and disappears.

At the same time that the vaccinal lesion disappears, the organic resistance to bacillary tuberculous infection weakens and disappears in its turn, and it is for this reason that the authors recommend revaccination every year. Hence it results as a résumé that the preservative action against tuberculosis, the action of fortification, as M. Guérin calls it, seems to be ascribed to two things: (1) to a defensive action resulting from the diffusion of manufactured tuberculinic toxins at the seat of the vaccinal focus by the tuberculinigenous bacilli in activity; and (2) to the defensive action resulting from the destruction of these same bacilli and of the progressive disappearance of the initial lesion, whatever be the mechanism of this destruction, disappearance, or elimination.

The authors consider that during this destruction there is a beneficial bacillo-cellular symbiosis.

Under these two conditions, the former being known as notoriously insufficient since the researches of Heymans and Moussu, one imagines a possible vaccinal action controlled experimentally, since Guérin mentions that animals vaccinated eighteen months previously have resisted perfectly mortal doses of virulent bacilli which carried off controls in two months. It is assuredly very fine, but it is very different from Vallée's method, since here there is quite progressive bacillary destruction and not proliferation in the walls of the vaccinal lesion; and if vaccinations and annual revaccinations allow of the establishing *that the resistance to virulent experimental or natural infections persists some years*, but not alone for months, then one can truly affirm that there is something useful in this matter of antituberculous vaccination. For it will no longer be new to establish that animals that have been submitted to the injection of tubercle bacilli of such and such origin, or even to injection of bacillary derivatives, resist virulent experimental inoculations better than healthy and fresh subjects, if afterwards they develop consecutive latent but temporary visceral infections susceptible at the end of a given time of evolving as ordinary lesions.

This was an idea already known in France before the experiments in Behring's method, besides it has formed the basis of all the discussions which have been raised by the inexact interpretation of the first results of these experiments. And it has been found fully and definitely confirmed.

To-day several other scientific data, of recent growth, justify reserve and prudence because they seem definitely accepted. They are as follows:—

1. The tuberculinigenous property of an avirulent bacillus appears only to play a partial rôle in antituberculous fortification, since in the old experiences of Heymans and myself on cultures *in vivo*, the increase of resistance revealed itself as insufficient even with the employment of virulent bacilli, susceptible of allowing their tuberculinic toxins to diffuse.

2. All those who have experimented, on laboratory animals at least, with avirulent bacilli, have come to this conviction, that the inoculated animals can support variable doses, more or less high, of these bacilli, to make or not local lesions, sometimes ulcerated, but susceptible of curing rapidly, but not conferring, however, any lasting resistance, any real consecutive vaccination.

This at least is what has happened many and many a time in the past with me, in researches which have never been published because I considered them to be of no value. Without doubt the B.C.G. of MM. Calmette and Guérin is not an avirulent bacillus, the process of obtaining it necessitates very special means of attenuation, giving probably different modifications of accidental or natural progressive attenuations established by other research workers; but all the same there is room to ask whether the bacillo-cellular organic symbiosis that they invoke to explain its beneficent effects is indeed a reality and not a view of the mind. So much the better if it is really so, but one is justified in asking why it has not been so for those who have made laboratory experimentation with avirulent bacilli.

3. Again, there is a final idea which seems quite fixed, and that is of the possibility of progressive recovery of virulence by tubercle bacilli of weak or very weak virulence. There is evidently in this idea a datum which shows all the difficulty of fixing hereditarily in a definite fashion properties which have been imposed artificially. And the recovery of the tuberculinigenous property of the B.C.G. is a new proof of it. Properties imposed artificially may be temporary and not durable. The future, a future which demands years, will alone reveal it. I sincerely hope that the definite bacillary domestication dreamed of by Guérin may be a reality and carry him to success and triumph.

Abstracts of Current Literature

Schlegel. M,—Eye Tuberculosis in Domestic Animals.—*Archiv f. W. and P. Tierheilkunde*, Vol. 48, 1922.

THE author describes seven cases of eye tuberculosis, six of which occurred in cattle and one in a hen. It usually arises as a secondary

infection in connection with tuberculosis of an organ, but it may be primary. Primary tuberculosis of the conjunctiva and eyelids of pigeons, fowls, and the cat is described. In cattle and swine eye tuberculosis starts in the iris and ciliary bodies. A nodular eruption arises on the anterior surface of the iris as well as the edge of the cilia and papilla. From here the process spreads to the anterior chamber of the eye, cornea, and sclera, and then on to the lens, vitreous humour, choroid and retina, and eventually turns the whole eye into a caseous and calcified mass.

Hamoir, J.—Osseous Tuberculosis.—*Echo Vétérinaire*, June 1923.

Two cases of osseous tuberculosis caused lameness in cattle. Externally it was indicated respectively by diffuse, hard, and indolent swellings of the cannon bone of the left anterior and posterior limbs, and an enormous tumour of the brachial region of the right fore limb, reaching to the humerus and covering the point of the shoulder. In the first case diagnosis was uncertain between lymphadenoma, osteomalacia, and tuberculosis, although the glands did not show the usual tuberculous characteristics. The injection of tuberculin gave a positive reaction. At the autopsy slight visceral lesions were found and osseous tuberculosis lesions, consisting of osteomyelitis, condensing ostitis thickening the diaphysis, and osteoperiostitis causing osteophytic vegetations, deforming the surface of the bones.

In the second case the diagnosis was uncertain, varying between osteo-sarcoma, actinomycosis, hydatic cysts, exuberant callus, and pseudo-arthrosis. Exploratory puncture gave a serous yellow liquid, only containing very few acid fast bacilli. The autopsy showed rarefying epiphysary osteitis strewn with fibrous tuberculous follicles with typical giant cells. The author thinks that osseous tuberculosis is more frequent than is suspected, and that in affections of bone not of traumatic origin tuberculosis ought to be borne in mind. Spongy bone and the epiphysis of long bones are the sites of preference, being more richly supplied with fluids, increasing the chance of hematogenous infection. Diaphysary tuberculosis is rare; it begins in the medulla, causing condensing osteitis and osteogenetic periostitis.

Morishita, K. O. R., 1924.—A Pig Nematode, "Gnathostoma hispidum," as a Human Parasite.—*Ann. Trop. Med. and Parasit.*, vol. xviii. p. 23.

FOUR cases of gnathostoma have previously been reported from man. In all these cases, however, the parasite was *G. spinigerum*, a worm found in domestic and wild carnivores. This is the first record of *G. hispidum* of the pig from a human source. The parasite in the pig is found in the stomach. In the abnormal host it was found in

the abnormal habitat under the skin, where it caused a " creeping " disease. The symptoms disappeared with the removal of the worm.

On the Question of the Transmissibility of Foot-and-Mouth Disease to Wild Animals.—Communicated by the Official Veterinary Body. *Schweizer Archiv für Tierheilkunde*, August 31, 1924.

ACCORDING to the few contributions to the literature of this subject, the susceptibility of wild cloven-footed animals to foot-and-mouth disease is doubtful. Investigations conducted by us in different outbreaks in conjunction with the cantonal veterinary surgeons on shot roebuck and chamois were without exception negative. But the following shows that artificial transmission of the disease to wild cloven-footed animals can be carried out. A chamois that had strayed into a herd badly infected with foot-and-mouth disease was caught, and infected with the virus by scarification of the oral mucosa and smearing on of saliva from a freshly infected cow. On the fourth day afterwards the chamois showed, at different places on the tongue, hard palate edges of the upper gums, as well as on the upper and under lips several typical vesicles. In the remaining parts of the body and especially in the claws no changes of any kind could be found.

In order to confirm the diagnosis it was necessary to retransmit the disease to naturally susceptible animals, and the chamois was conveyed with all due precautions to the Zurich abattoir. There it was placed in the closed isolation room and further experiments were made by Dr. Schellenberg, of Zurich. On the morning of July 24th a pig, and in the afternoon a cow and a bullock, were put in the chamber with the chamois. The infection of these trial animals was sought by giving saliva and dung of the chamois *per os.*

On July 25th the chamois suddenly got much worse and was slaughtered. *Post-mortem* showed ulcers in the nose, nasal discharge, ulcers in the mouth and on the gums and healing ulcers on the tongue, fibrin clots and serous fluid in the abdominal cavity, ulcers in the stomachs, brownish yellow deposits in the liver, liver parenchyma swollen and dark reddish-brown. No abnormalities of the external skin and feet nor of the urino-genital apparatus.

On the eighth day after transmission the bullock showed the first symptoms of illness in the form of rise of temperature, staring coat, inflamed spots in the mouth and salivation. On the ninth day a typical vesicular exanthema of the mucous membrane of the mouth was noticeable. In the cow there was a noticeable heightened bodily temperature on the ninth day.

Post-mortem on the bullock showed well-marked lesions in the

mouth and stomachs, but nothing abnormal in the urino-genital organs and feet.

No changes at all occurred in the cow and pig.

This experiment shows that wild animals may be infected with the aphthus virus. The question whether they can be infected with it under natural conditions is not certain and remains unsolved. But it is pretty certain that under certain conditions wild animals may act as intermediate carriers of infection.

Notice

"DOGS AND HARD TACK."

UNDER the above heading, which is an especially appropriate one to utilise in the present day as one of the chief keynotes of the hygiene and feeding of the dog, any veterinary surgeon may receive, upon application, a small brochure published by Messrs. Wright & Co., Dog Biscuit Manufacturers, of the Vulcan Street Mills, Liverpool. It is prefaced by a few lines of recommendation from that well-known veteran of sport and sporting dogs, Major Harding Cox.

The main object, no doubt, with which it is written is to increase the sale of Messrs. Wright's dog biscuits and dog food preparations, which have already gained golden opinions from all classes of breeders and owners of show dogs; but the point which it emphasises from the veterinary aspect is that if a healthy dog's teeth and stomach had more normal work thrown upon them by compelling the animal to break up and eat dry, hard biscuit (instead of the soft, mushy, sloppy messes which are given day after day in the average household and kennel) we should see less of pyorrhœa and other tooth troubles, and also have less of the digestive disorders which form so large a part of the canine practice of the present day.

NOTICES

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